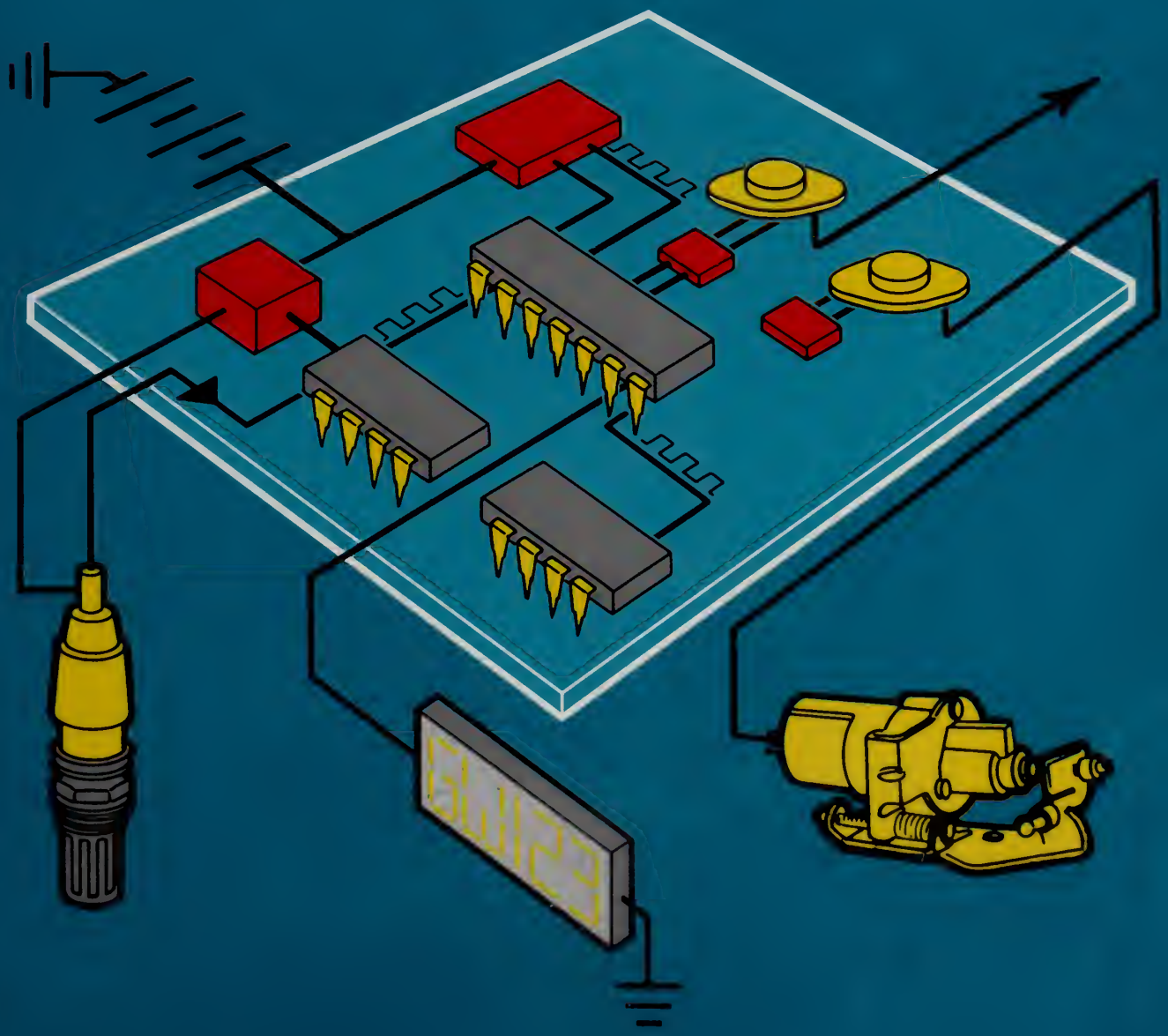
Workbook

Auto Electricity and Electronics

TECHNOLOGY

Henke-Konopasek/Duffy



Principles, Diagnosis, Testing, and Service of All Major Electrical, Electronic, and Computer Control Systems

Workbook

Auto Electricity and Electronics

TECHNOLOGY

by

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and

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South Holland, Illinois
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Publishers

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2 3 4 5 6 7 8 9 10 95 98 97 96 95

With few exceptions, this workbook is compatible with the 1989 edition of the textbook AUTO ELECTRICITY, ELECTRONICS, COMPUTERS.

IMPORTANT SAFETY NOTICE

Proper service and repair methods are critical to the safe, reliable operation of automobiles. The procedures described in this workbook are designed to help you use a manufacturer's service manual. A service manual will give the how-to details and specifications needed to do competent work.

This book when completed, contains safety precautions which must be followed. Personal injury or part damage can result when basic safety rules are not followed. Also, remember that these cautions are general and do not cover some specialized hazards. Refer to a service manual when in doubt about any service operation!

INTRODUCTION

The WORKBOOK FOR AUTO ELECTRICITY AND ELECTRONICS TECHNOLOGY provides a teaching aid for the textbook AUTO ELECTRICITY AND ELECTRONICS TECHNOLOGY. It highlights important subject matter, improves understanding, and simplifies the text by requiring you to complete several different kinds of learning exercises.

Each workbook chapter serves as an "open book" test covering the content of the textbook. You must answer several types of questions as you read and study the text. As a result, the workbook also serves as a study guide, making sure you more fully comprehend the most important information.

The workbook contains conventional word-type problems: fill-the-blank, essay, true or false, and multiple choice. It also uses numerous illustration-type problems where you must identify parts, actions, and sometimes, even draw missing components, missing wires, arrows showing flow, etc. This balance between word and illustration-type problems will help you learn and stay interested in your study of automotive technology.

The last section of the workbook contains a sample ASE-type test. The questions relate to electrical system service and the information given in the textbook. The sample test will help prepare you for actual certification tests and show your strengths and weaknesses in this area of service.

As a student of automotive technology, you should find this workbook to be a very useful "learning tool." By restudying your answers, you can use it as a guide to prepare for instructor and certification tests.

N. Henke-Konopasek
J. Duffy

INSTRUCTIONS

■ Read the objective and general instructions for the workbook chapter. Then, use the following outline of procedures to help solve the workbook problems.

Completion problems:

1. Note the topic of the workbook section.
2. Find the text heading on the same subject. Read the textbook material and study the illustrations.
3. Read the incomplete workbook statement.
4. Determine the correct answer and print the missing words into the workbook blanks.

Definition problems:

1. Study the text material that matches the workbook heading.
2. Read the textbook paragraph that explains the workbook term to be defined.
3. Reduce the text information into a brief description of the term.
4. Neatly print your definition in the space provided in the workbook.

Multiple-choice problems:

1. Read and think about the statement.
2. Read through the possible answers.
3. Eliminate incorrect responses.
4. Circle letter of the most correct response.

True-false problems:

1. Read the statement.
2. Analyze the statement.
3. Circle true or false depending upon statement accuracy.

Matching problems:

1. Read and think about the statement.
2. Read through all of the terms.
3. Mentally note the terms that you associate with the statement.
4. Write the letter of the most correct term on the blank next to the statement.

Illustration problems:

1. Note the topic of the section of illustration.
2. Find the corresponding textbook heading. Read the text material and study the illustrations.
3. Identify as many of the parts in the workbook illustration as you can from memory.
4. Use the text illustration to help you restudy any part you cannot remember.
5. Draw any parts (wires, arrows, etc.) missing from the workbook illustrations. Use a ruler for all straight lines. Colored pencils may also be used to brighten and clarify your sketches.

Other problems:

1. When other types of workbook problems are given, follow the specific instructions at the top of the page.

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Chapter 1

INTRODUCTION TO AUTO ELECTRICAL-ELECTRONIC SYSTEMS

Name _____

Date _____ Period _____

Instructor _____

OBJECTIVE: After studying this chapter, you will be able to describe major electrical-electronic systems of an automobile.

INSTRUCTIONS: As you study the text, complete the workbook problems.

THE ELECTRONIC REVOLUTION

1. _____ devices are being used to monitor and control almost all critical assemblies in cars.
2. Describe the difference between an electrical device and an electronic device. _____

_____

_____

_____

_____

_____

_____

3. Explain why electrical devices have replaced many mechanical devices in automobiles. ____

_____

_____

4. The _____ _____ is trained to diagnose and repair the many systems of a car that use electrical-electronic devices.
5. What is necessary if you are to properly troubleshoot and repair today's complex, interacting vehicle systems? _____

_____

THE COMPUTER NETWORK

6. Define the term "computer network." _____

_____

_____

Name _____

THE COMPUTER NETWORK (Continued)

7. Name and describe three basic components of the computer network or computer system.

   _____: _____

   _____

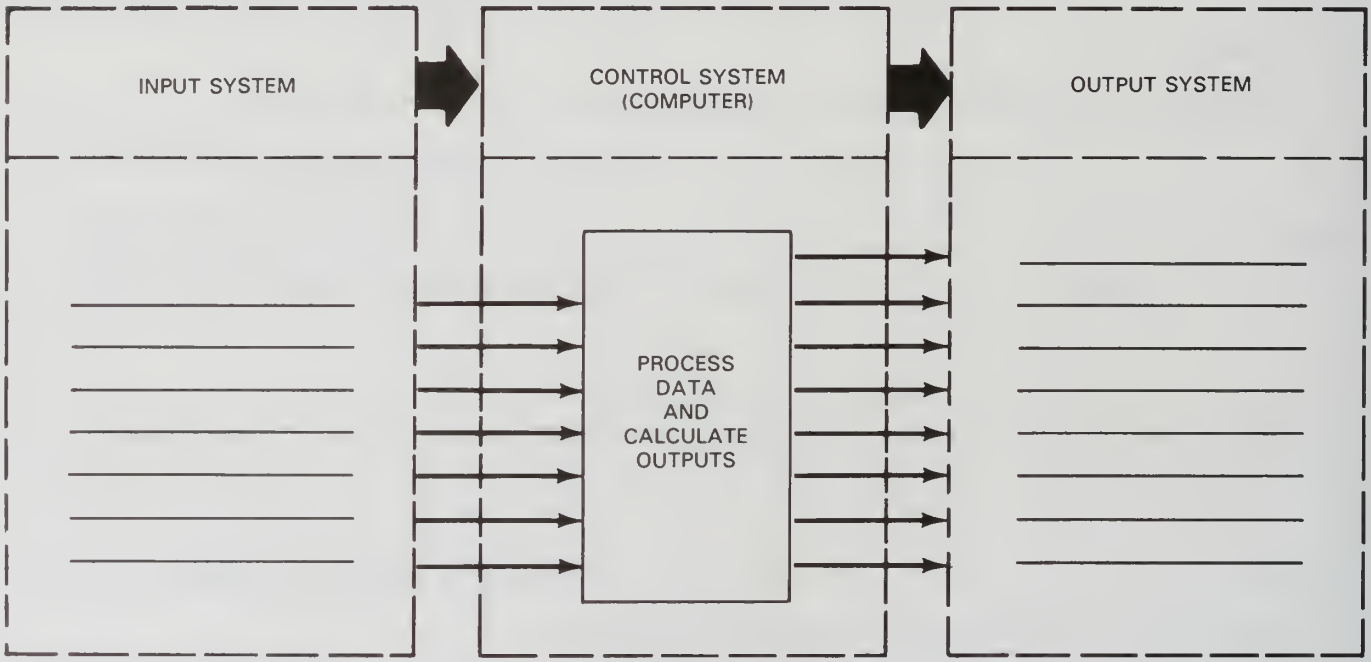
   _____: _____

   _____

   _____: _____

   _____

8. The _____ _____ serve as the "eyes, ears, and nose" of the computer network.
9. In the block diagram below, fill in the columns under input or sensing system and output or actuator system.

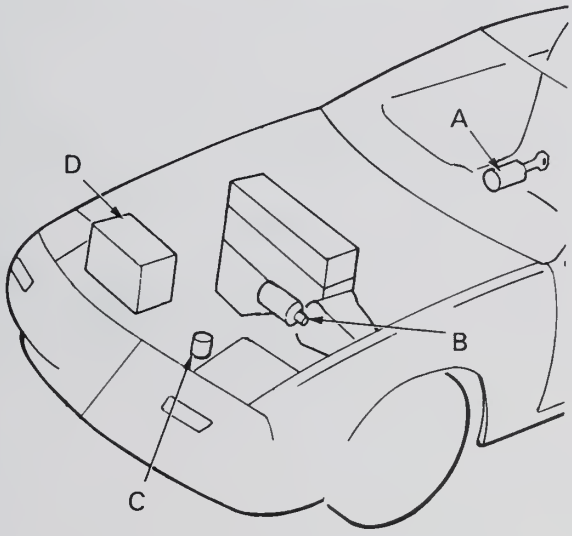


10. The car's _____, also called _____ or electronic control unit, is a super-complex set of electronic circuits that use sensor inputs to produce programmed (predetemined) outputs.
11. A(n) _____ is a device that uses electrical energy and engine vacuum, pressure, or a combination of each to do work.
12. Most computer systems have _____-_____ which means the computer can scan or locate problems and inform the driver or technician of specific malfunctions.

Name _____

THE STARTING SYSTEM

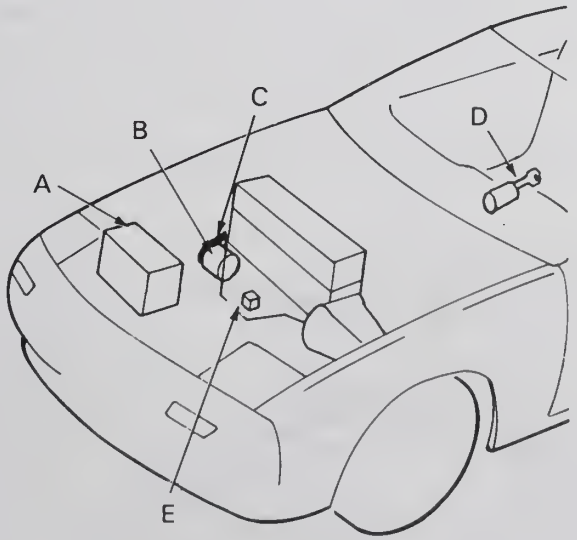
13. The starting system uses _____ power and a powerful _____ _____ to rotate the engine crankshaft.
14. Draw in the wiring that connects the four major components of the starting system. Then identify the parts indicated on the diagram below.



A. _____
B. _____
C. _____
D. _____

CHARGING SYSTEM

15. The charging system forces current back through the _____ for recharging and also provides electricity for all of the electrical devices with the engine running.
16. Draw in the wiring that connects the parts of the charging system. Then identify the parts indicated on the diagram below.



A. _____
B. _____
C. _____
D. _____
E. _____

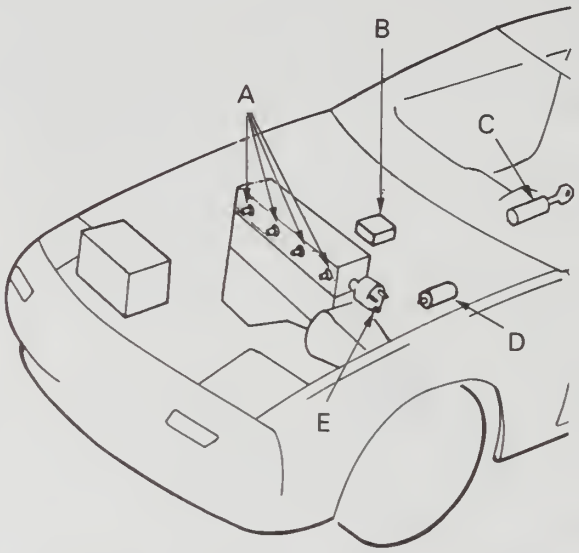
Name _____

IGNITION SYSTEM

17. The ignition system is used to: _____

_____

18. Draw in the wiring that connects the parts of the ignition system. Then identify the parts indicated on the diagram below.



A. _____
B. _____
C. _____
D. _____
E. _____

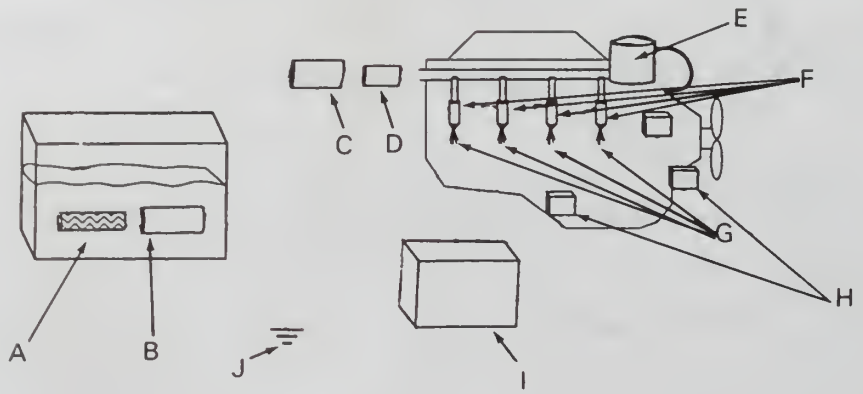
FUEL SYSTEM ELECTRONICS

19. Fuel _____ are actuators that simply open and close small fuel spray nozzles into the engine intake manifold.

20. Draw in the wiring and fuel lines of the fuel system. Then identify the parts indicated on the diagram below.

A. _____
B. _____
C. _____
D. _____
E. _____

F. _____
G. _____
H. _____
I. _____
J. _____



Name _____

LIGHTING SYSTEM

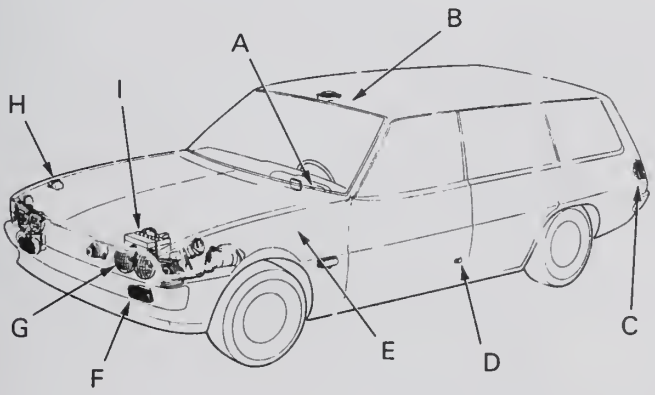
21. Name three examples of how electronics are used in an automotive lighting system.

_____

_____

_____

22. Draw in the wiring of the lighting system. Then identify the parts indicated on the diagram below.

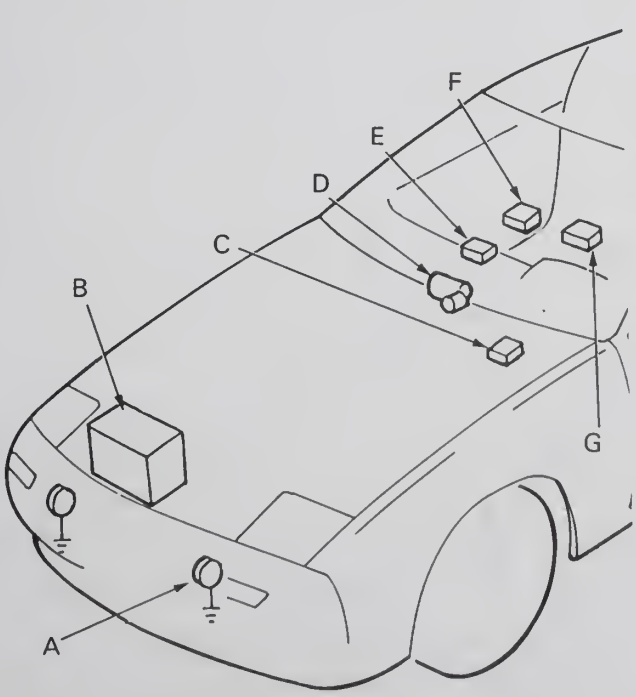


A. _____
B. _____
C. _____
D. _____
E. _____
F. _____
G. _____
H. _____
I. _____

WIPER-WASHER AND HORN SYSTEMS

23. The wiper-washer system is primarily _____ (electrical, electronic).

24. Draw in the wiring of the horn and wiper system. Then identify the parts indicated on the diagram below.



A. _____
B. _____
C. _____
D. _____
E. _____
F. _____
G. _____

Name _____

POWER LOCKS, SEATS, AND WINDOWS

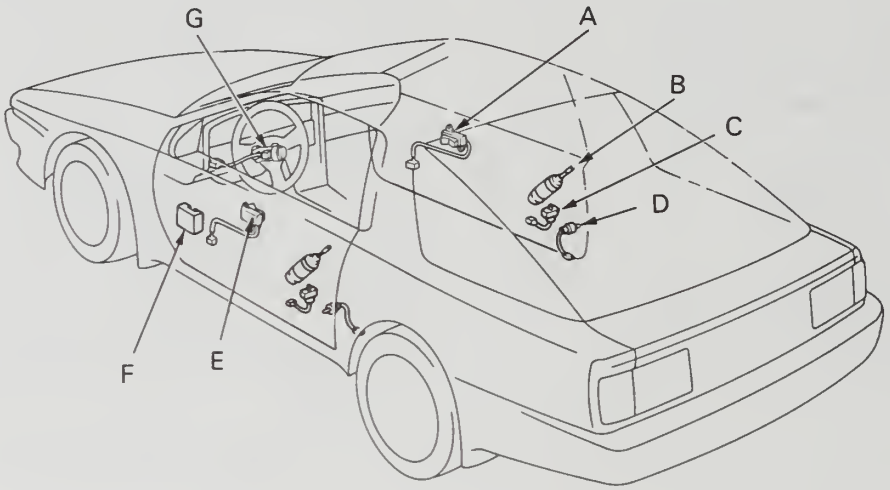
25. Draw in the wiring of the power door locks and power windows. Then identify the parts indicated on the diagram below.

A. _____ E. _____

B. _____ F. _____

C. _____ G. _____

D. _____



SOUND SYSTEMS

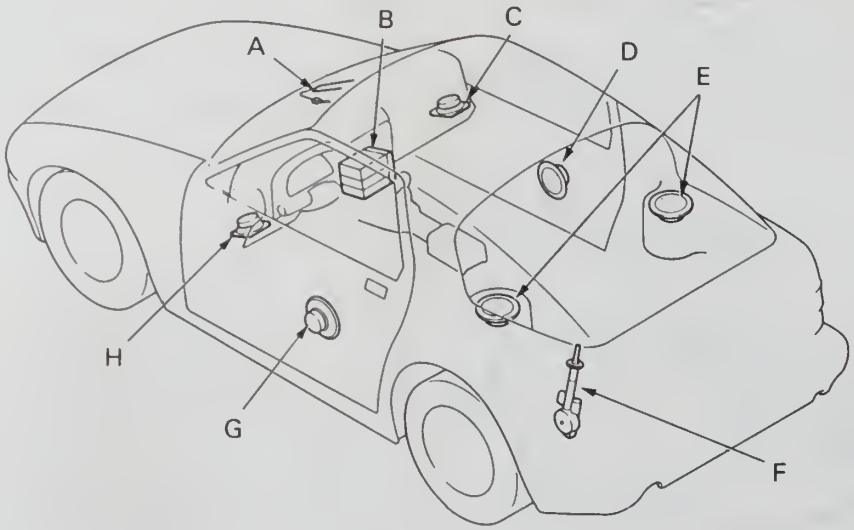
26. Draw the wiring of the sound system. Then identify the parts indicated on the diagram below.

A. _____ E. _____

B. _____ F. _____

C. _____ G. _____

D. _____ H. _____



Name _____

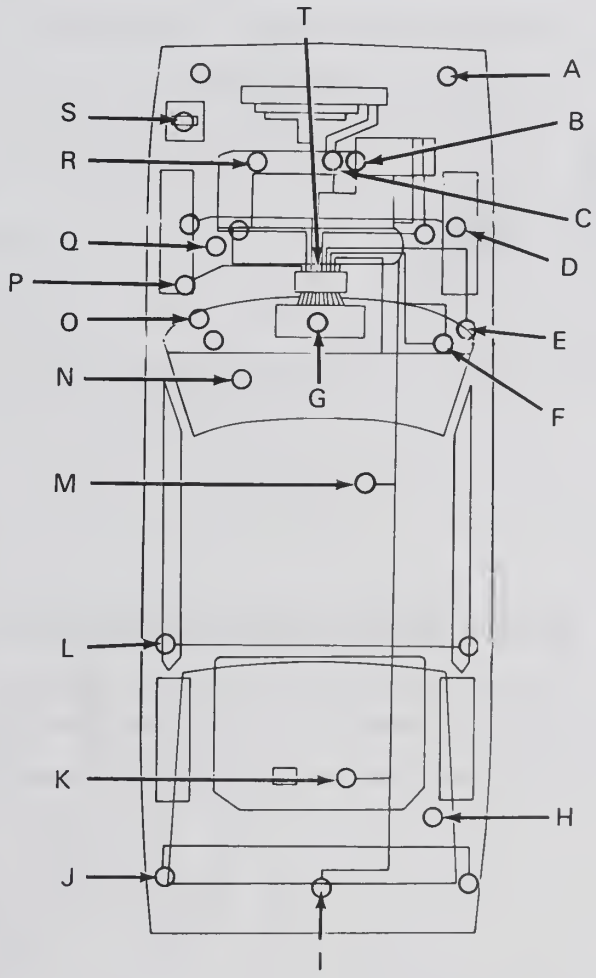
VOICE ALERT SYSTEMS

27. How does a voice alert system inform the driver of vehicle conditions? _____

_____

_____

28. Identify the various sensors used in voice alert systems.



A. _____ K. _____

B. _____ L. _____

C. _____ M. _____

D. _____ N. _____

E. _____ O. _____

F. _____ P. _____

G. _____ Q. _____

H. _____ R. _____

I. _____ S. _____

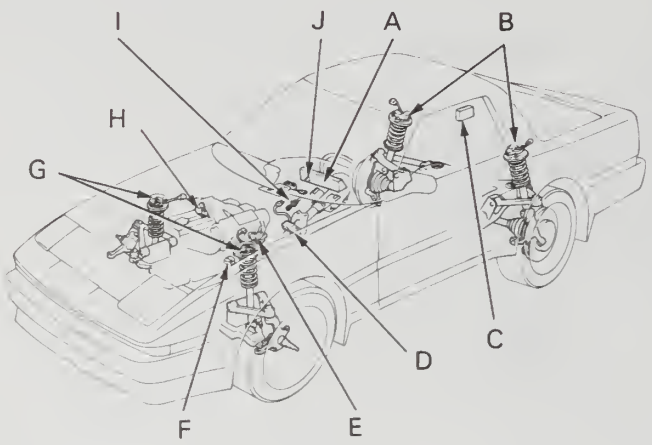
J. _____ T. _____

Name _____

SUSPENSION SYSTEM ELECTRONICS

29. An automatic suspension control system uses a _____, a _____ sensor, the _____ sensor, _____ sensor, and _____ _____ actuators to control shock stiffness.

30. Identify the parts indicated on the diagram of the suspension system below.

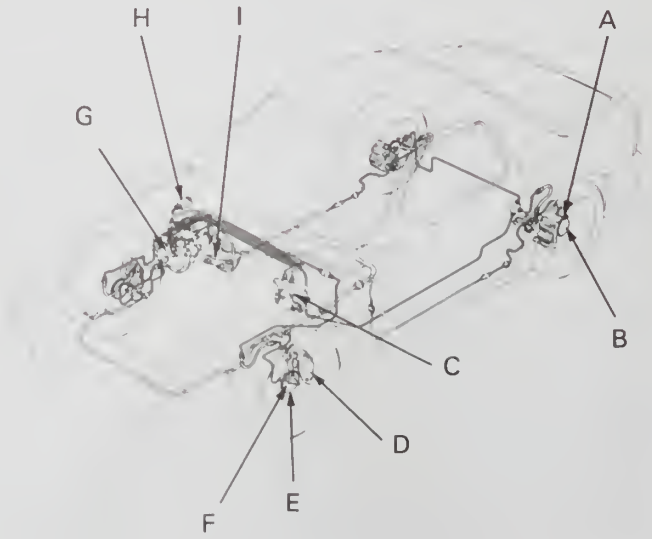


A. _____
B. _____
C. _____
D. _____
E. _____
F. _____
G. _____
H. _____
I. _____
J. _____

BRAKE SYSTEM ELECTRONICS

31. A(n) _____ brake system uses wheel speed sensors, a hydraulic actuator, and a computer to maintain directional stability and steerability during braking.

32. Draw in the hydraulic lines of the brake system. Then identify the parts indicated on the diagram below.



A. _____
B. _____
C. _____
D. _____
E. _____
F. _____
G. _____
H. _____
I. _____

Chapter 2

ELECTRICAL PRINCIPLES

Name _____

Date _____ Period _____

Instructor _____

OBJECTIVE: After studying this chapter, you will be able to explain basic principles of electricity.

INSTRUCTIONS: As you study the text, complete the workbook problems.

ATOMIC STRUCTURE

1. Match the following parts of matter with their descriptions.

_____ 1. Atom.	a. A small group of different elements.
_____ 2. Element.	b. A group of one type of atoms.
_____ 3. Molecule.	c. A group of different molecules.
_____ 4. Compound.	d. The smallest particle in matter.

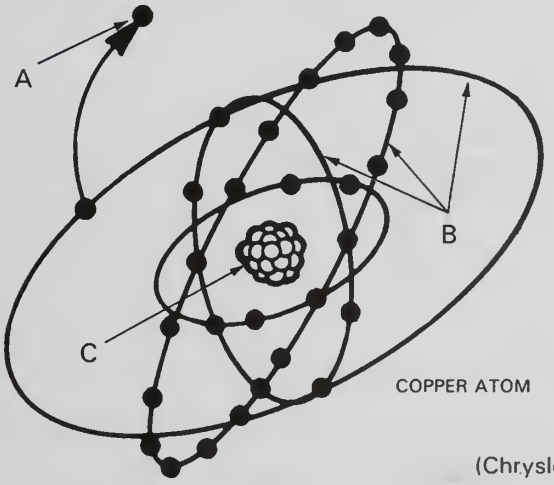
2. List the three basic parts of an atom and indicate whether the charge is positive, negative, or neutral.

_____

_____

_____

3. Identify the items indicated on the illustration below.



COPPER ATOM

(Chrysler)

A. _____

B. _____

C. _____

ELECTRICITY

4. Define electricity. _____

_____

_____

5. If you have a(n) _____ charge (excess electrons) on one end of a wire and a(n) _____ charge (excess protons) on the other end, electrical flow or discharge will result.

Name _____

ELECTRICITY (Continued)

6. True or false? If there is enough potential difference, an electron can enter the orbit in a new atom.
7. A(n) _____ (conductor, insulator) is a substance that allows the flow of free electrons. A(n) _____ (conductor, insulator) is a substance that resists or stops the flow of electricity.
8. Various materials are listed below. If the material is an insulator, identify it with an "I." If a material is a conductor, identify it with a "C."

_____ Plastic.
_____ Porcelain.
_____ Copper.
_____ Aluminum.
_____ Silver.
_____ Rubber.
_____ Glass.
_____ Iron.

9. List the three basic functions of electricity.

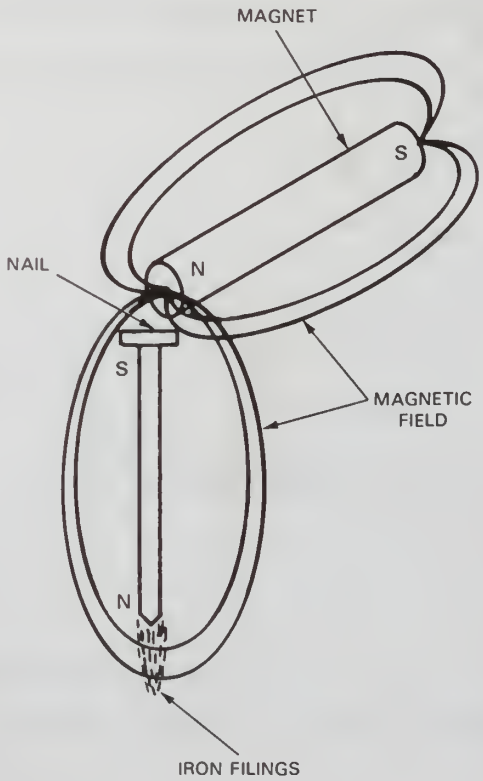
_____

_____

_____

MAGNETISM

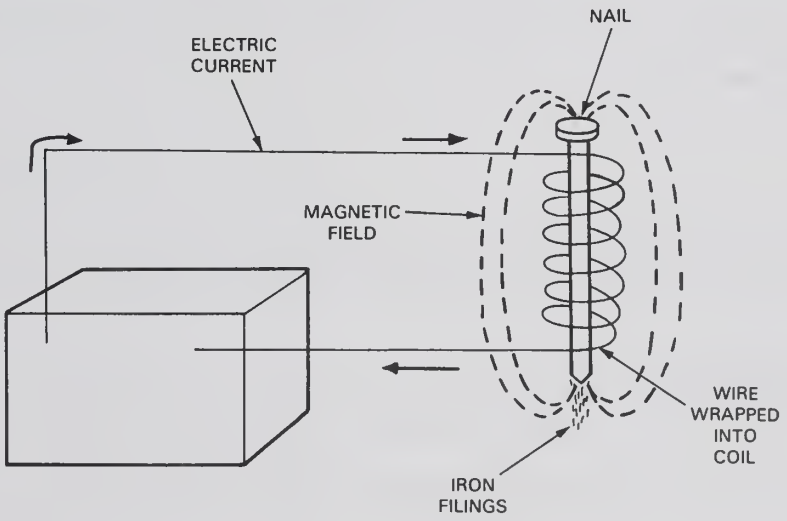
10. True or false? Magnetism is an atomic force that can attract or repel through space, air, or solid matter.
11. In the diagram below, the magnet activity on the nail shows the effect of magnetic _____.



Name _____

MAGNETISM (Continued)

12. A magnetic field has little or no effect on all of the following EXCEPT:
    a. Glass.
    b. Iron.
    c. Plastic.
    d. Wood.
13. Like charges _____ (attract, repel), and unlike charges _____ (attract, repel).
14. _____ is a branch of physics that deals with the interaction of electricity and magnetism.
15. In the illustration below, a(n) _____ has been made by wrapping wire around an iron core. Current through the wire will produce a _____ (weak, powerful) magnetic field.



16. What results when a wire carrying electricity produces an electrical current in another wire?

_____

SIMPLE ELECTRIC CIRCUIT

17. List and describe the three basic components of a simple electrical circuit. Give an example of each.

_____

_____

_____

_____

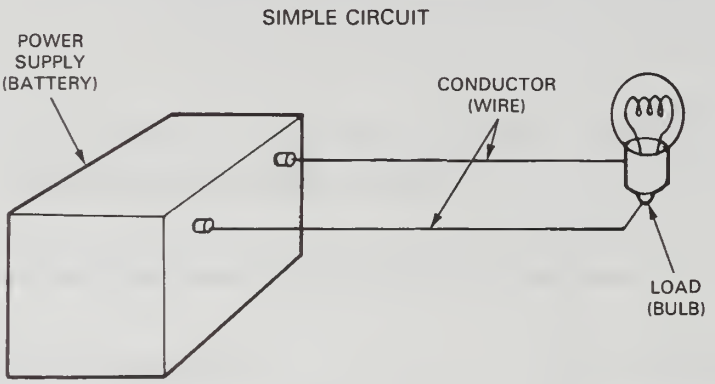
_____

_____

Name _____

SIMPLE ELECTRIC CIRCUIT (Continued)

18. Draw in arrows to show a simple or basic electric circuit.



ELECTRICAL VALUES

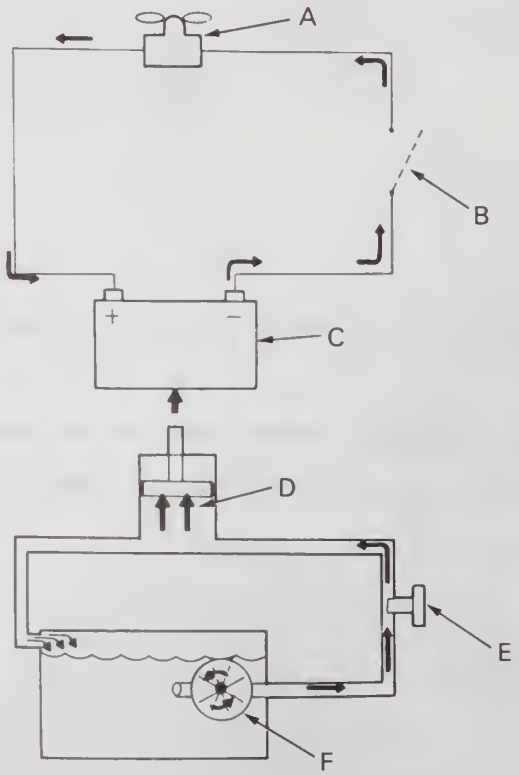
19. List and describe the three fundamental values that refer to the properties of electricity and a simple electrical circuit.

_____

_____

_____

20. Identify the parts indicated on the electrical circuit and hydraulic circuit below.



A. _____

B. _____

C. _____

D. _____

E. _____

F. _____

Name _____

ELECTRICAL VALUES (Continued)

21. A _____ (lower, higher) voltage will tend to increase current flow. A _____ (lower, higher) voltage will reduce current flow.
22. _____ _____ is another name for voltage and refers to how voltage has the power or force to cause electron movement through a conductor.
23. _____ flow will be high if resistance is low or voltage is high. It will be reduced by high resistance or a low supply voltage.
24. _____ is another name for current.
25. _____ is another name for resistance.
26. True or false? Resistance is designed into all electrical circuits.
27. Describe the Conventional Theory.

_____

_____

_____

_____

_____

28. Describe the Electron Theory.

_____

_____

_____

_____

29. _____ (Electron, Conventional) Theory is used in automotive electronics.
30. _____ (Direct, Alternating) current is current flow in only one direction. _____ (Direct, Alternating) current flows one direction, reverses, and then flows in the opposite direction.

Chapter 3

ELECTRICAL CIRCUITS, OHM'S LAW

Name _____

Date _____ Period _____

Instructor _____

OBJECTIVE: After studying this chapter, you will be able to identify electrical circuits and describe Ohm's Law.

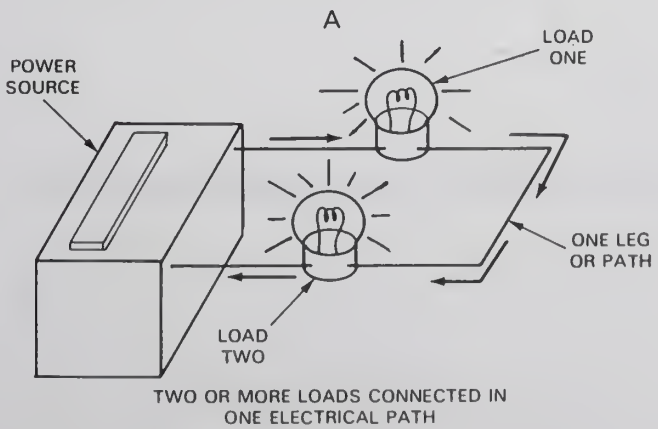
INSTRUCTIONS: As you study the text, complete the workbook problems.

TYPES OF CIRCUITS

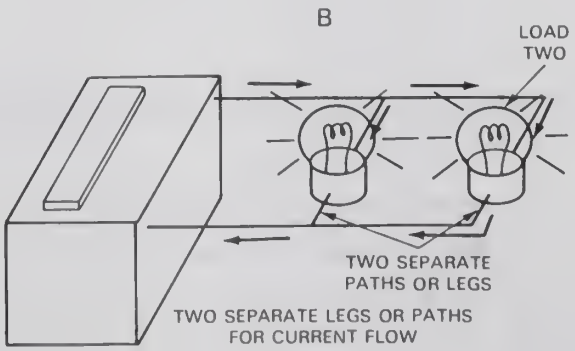
1. Simple _____ circuits have more than one load connected in a single electrical path.
2. Suppose a string of Christmas tree lights was wired in series. If one bulb burned out:
   a. All the other Christmas tree lights would remain on because the current would continue to flow.
   b. All the other Christmas tree lights would go out because the burned element in the bulb would act as an open switch to stop current flow.
   c. The bulbs next to it would burn out, but the others would continue to function.
   d. None of the above.
3. A(n) _____ circuit has more than one path for current flow.
4. Suppose a string of Christmas tree lights was wired in parallel. If one bulb burned out:
   a. All the other Christmas tree lights would go out because the burned element in the bulb would act as an open switch to stop current flow.
   b. The bulbs next to it would burn out, but the others would continue to function.
   c. All the Christmas tree lights, except the burned out bulb, would continue to function because there would still be a complete path around the burned-out bulb.
   d. None of the above.
5. Identify the circuits shown below.

A. _____

B. _____



TWO OR MORE LOADS CONNECTED IN ONE ELECTRICAL PATH



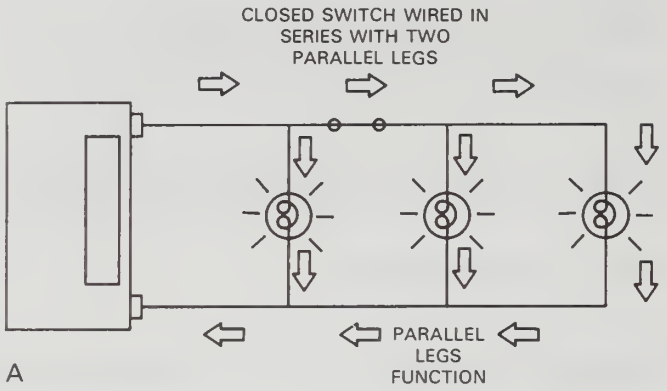
TWO SEPARATE LEGS OR PATHS FOR CURRENT FLOW

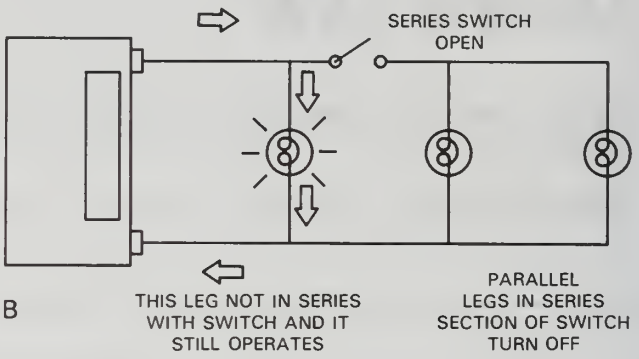
Name _____

TYPES OF CIRCUITS (Continued)

6. Identify the type of circuit shown in the diagrams below. _____

_____

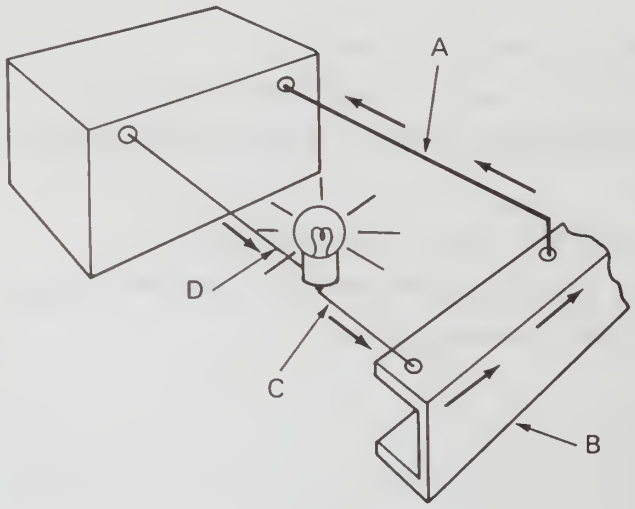



SERIES SWITCH OPEN
THIS LEG NOT IN SERIES WITH SWITCH AND IT STILL OPERATES
PARALLEL LEGS IN SERIES SECTION OF SWITCH TURN OFF
B

7. A(n) _____-_____ circuit, also called a one-wire circuit, uses the metal structure of the car to return current to the source (car battery).
8. Identify the circuit shown in the illustration below and identify the items indicated. _____

_____

A. _____
B. _____
C. _____
D. _____



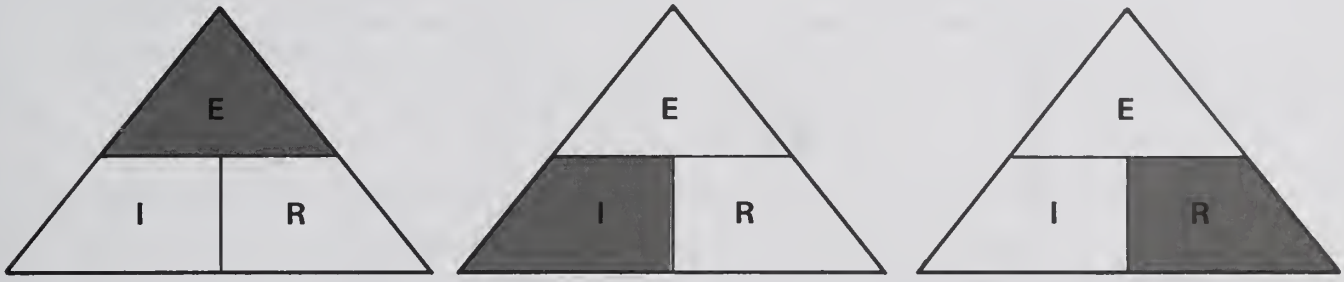
9. Which of the following refers to the section of the circuit that carries current to a load or component?
   a. Hot leg or hot wire.
   b. Ground leg or ground wire.
   c. Either hot leg or ground wire.
   d. None of the above.

Name _____

OHM'S LAW

10. Ohm's Law is a simple formula used to express the relationship between _____, _____, and _____.

11. Ohm's Law states three basic formulas. Look at the triangles below and write the formulas below.



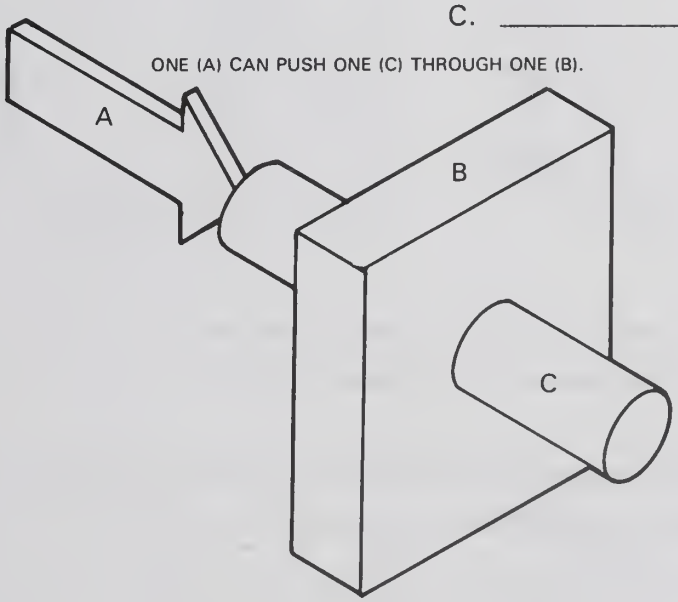
A. _____ B. _____ C. _____

12. Identify the items represented by this diagram.

A. _____

B. _____

C. _____



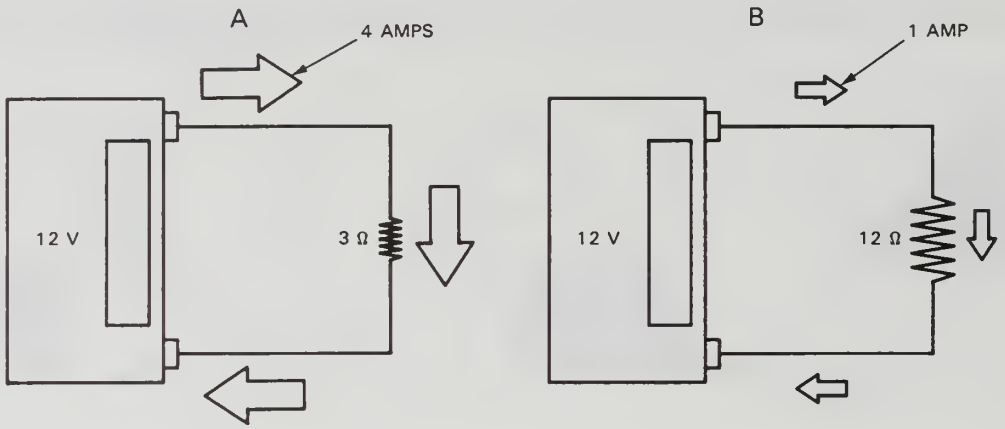
13. In auto electronics, most electrical problems are caused by a change in _____ _____.

Name _____

OHM'S LAW (Continued)

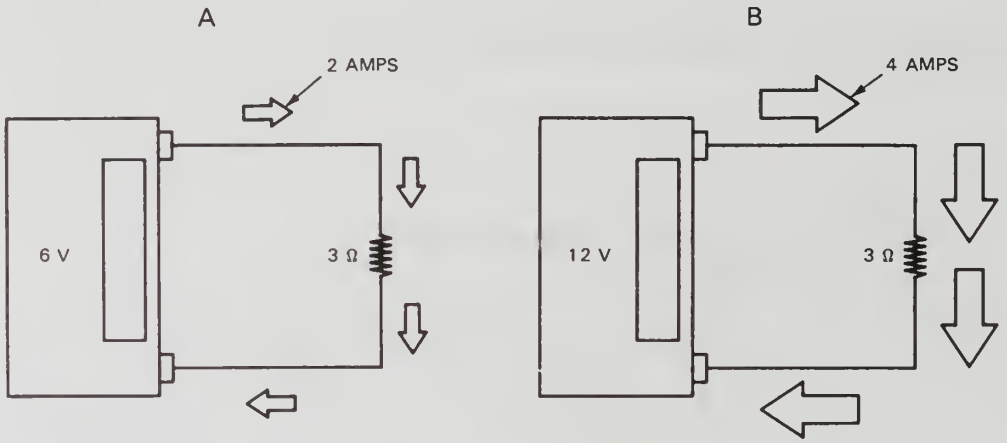
14. Which of the circuits below has less current?

_____



15. Which of the circuits below has higher current?

_____

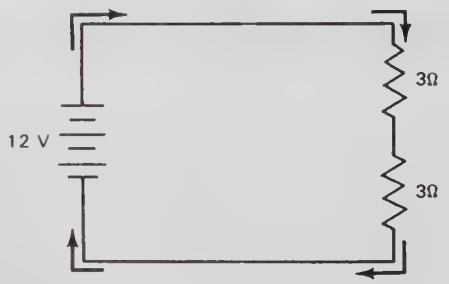


16. True or false? Current or amperage is the same everywhere in a series circuit.
17. What is the formula for total resistance in a series circuit? _____

_____

18. True or false? The voltage drop across each resistance unit equals voltage applied.
19. In the series circuit below, determine current flow. _____

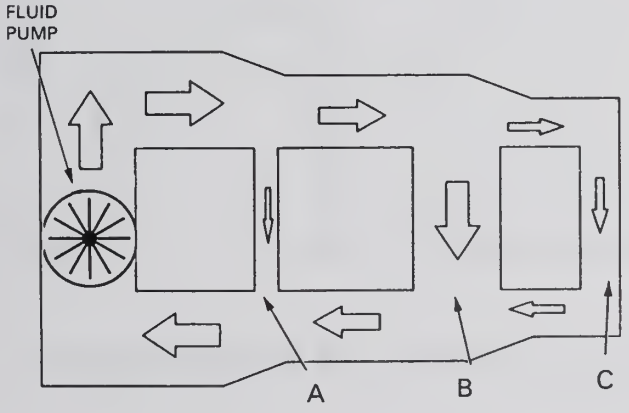
_____



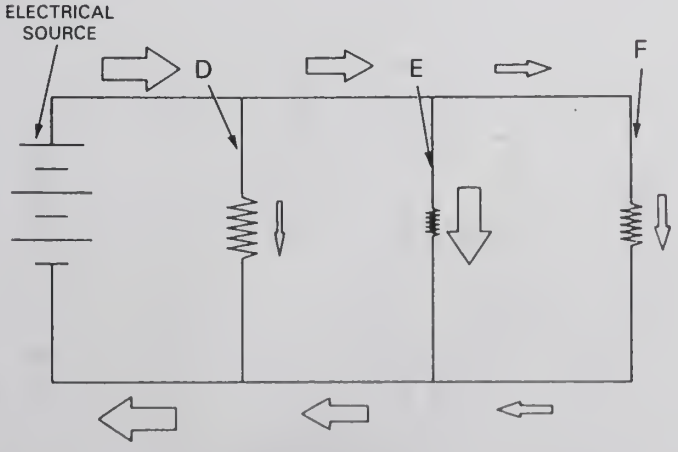
Name _____

OHM'S LAW (Continued)

20. In a parallel circuit, if you have three branches carrying two amps each, then the total circuit current would be:
    a. 6 amps.
    b. 5 amps.
    c. 1 amp.
    d. None of the above.
21. In a parallel circuit, total circuit resistance is _____ (less, more) than any one branch.
22. True or false? In a parallel circuit, voltage applied to each branch is the same.
23. True or false? Current follows the path of most resistance.
24. True or false? Series circuit operation is more complex than parallel circuit operation.
25. Look at the diagrams below. Indicate whether resistance is low, medium, or high. Also indicate whether current flow is little, medium, or high.



A. Resistance: _____
Flow: _____
B. Resistance: _____
Flow: _____
C. Resistance: _____
Flow: _____



D. Resistance: _____
Flow: _____
E. Resistance: _____
Flow: _____
F. Resistance: _____
Flow: _____

Name _____

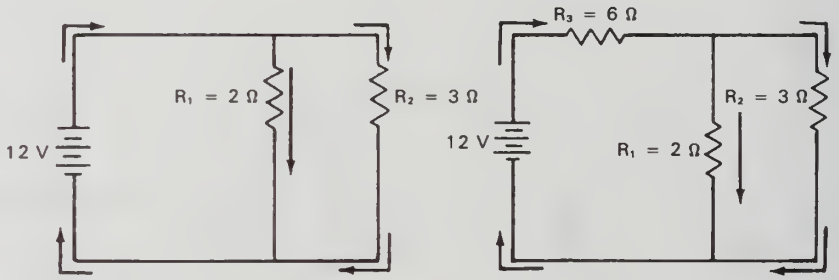
OHM'S LAW (Continued)

26. What is the formula for finding total resistance in a parallel circuit?

27. Find the total resistance and amps for the parallel circuit below. (Use the space provided for calculations.)

Total resistance _____

Amps _____

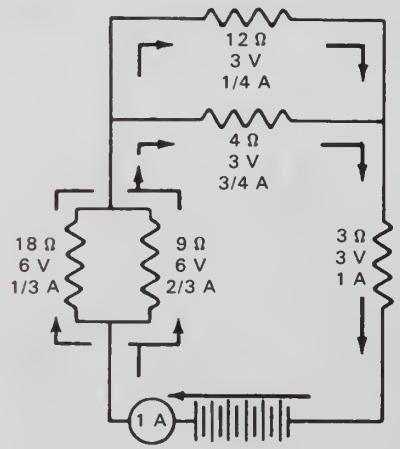


28. Determine the following values for the series parallel circuit below. (Use the space provided for calculations.)

V_t = _____

R_t = _____

I_t = _____



Name _____

PREFIXES

29. Complete the chart below by filling in the correct prefixes and symbols.

MULTIPLIER	EXPONENT FORM	PREFIX	SYMBOL
1 000 000 000 000	10^{12}		
1 000 000 000	10^{9}		
1 000 000	10^{6}		
1 000	10^{3}		
10	10^{1}		
0.1	10^{-1}		
0.01	10^{-2}		
0.001	10^{-3}		
0.000 001	10^{-6}		
0.000 000 001	10^{-9}		
0.000 000 000 001	10^{-12}		

ELECTRICAL POWER

30. Electrical power is work done by an electrical current, and its unit of measurement is the _____.

31. List two formulas for watts.

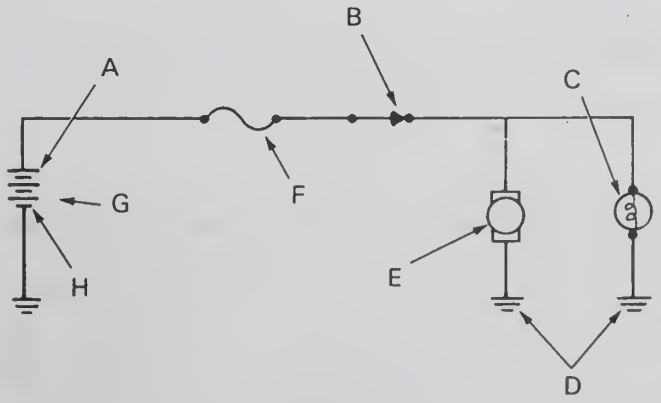
_____

_____

ELECTRICAL-ELECTRONIC SYMBOLS

32. _____ _____ serve as "electrical road maps" that show how all wires connect to the components in a circuit.

33. Identify the items indicated on the diagram below.



A. _____

B. _____

C. _____

D. _____

E. _____

F. _____

G. _____

H. _____

Name _____

ELECTRICAL-ELECTRONIC SYMBOLS (Continued)

34. Identify the purpose of the electrical-electronic symbols shown below.

+	
−	
Ω	

J2 2	
88:88	
TIMER	
#36	
#19 STRG COLUMN	
INST PANEL #14	

35. True or false? Electrical-electronic symbols and diagrams can vary in different service manuals.

Chapter 4

ELECTRICAL COMPONENTS

Name _____

Date _____ Period _____

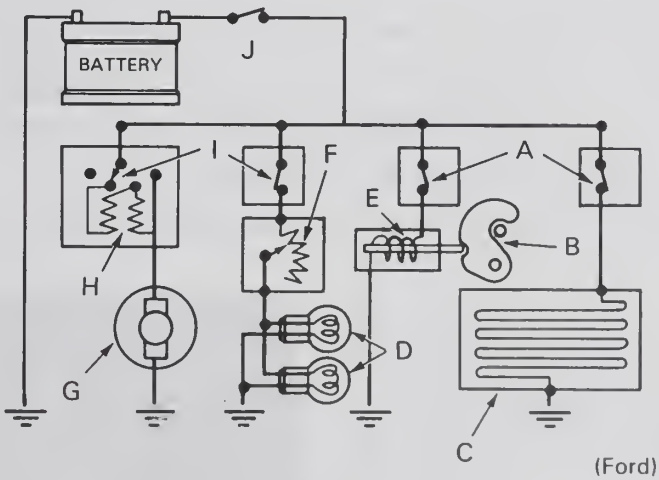
Instructor _____

OBJECTIVE: After studying this chapter, you will be able to identify and describe various electrical components.

INSTRUCTIONS: As you study the text, complete the workbook problems.

RESISTORS

1. Which of the following is an electrical component?
   a. Resistor.
   b. Transistor.
   c. Integrated circuit.
   d. None of the above.
2. Which of the following is an electronic or solid state component?
   a. Condenser.
   b. Relay.
   c. Diode.
   d. None of the above.
3. Identify the electrical components on the illustration below.



(Ford)

A. _____ F. _____

B. _____ G. _____

C. _____ H. _____

D. _____ I. _____

E. _____ J. _____

Name _____

RESISTORS (Continued)

4. A(n) _____ limits current flow or utilizes the electric current in a circuit.
5. Identify the item below. Give its symbol, letter designation, and describe its purpose.

Item: _____

Symbol: _____

Letter designation: _____

Purpose: _____

_____

6. Some larger, fixed resistors have a color code to denote the:
   a. Watt rating.
   b. Resistor tolerance.
   c. Ohms or resistance value.
   d. All of the above.
7. When replacing a resistor, the watt rating must be the same or _____ (higher, lower) to prevent the resistor from overheating or burning up in service.
8. A(n) _____ _____ is a percent value representing how much the Ohms value of a resistor can vary above or below the stated specification.
9. A(n) _____ resistor alters its own internal resistance as current flow changes.
10. A(n) _____ resistor is designed to have two or more ohms values available by connecting different taps or locations on the resistor.
11. Identify the item below. Give its symbol, letter designation, and describe its purpose.

(Union Electronic Distributors)

Item: _____

Symbol: _____

Letter designation: _____

Purpose: _____

_____

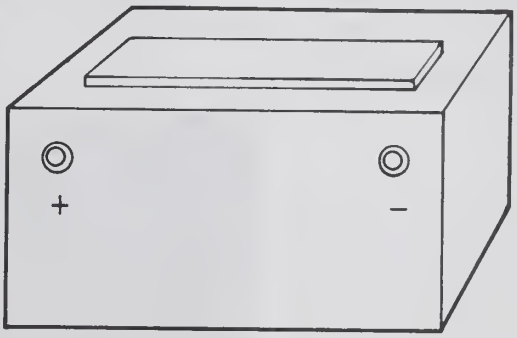
Name _____

RESISTORS (Continued)

12. A(n) _____ is a variable resistor with two electrical connections for its circuit.
13. A(n) _____ is a variable resistor with three electrical connections that allow for more complex use of the variable resistance.

BATTERIES

14. Identify the item below. Give its symbol, letter designation, and describe its purpose.



Item: _____

Symbol: _____

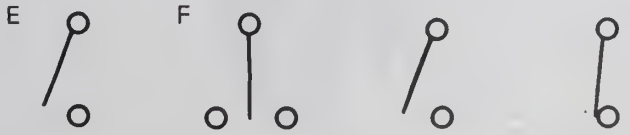
Letter designation: _____

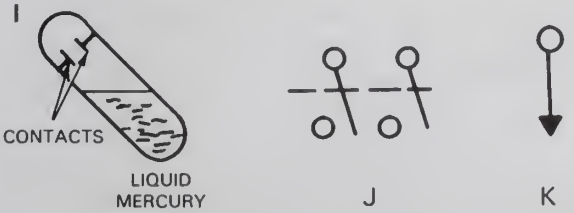
Purpose: _____

_____

SWITCHES

15. Identify the various switches represented by the symbols below.





A. _____
B. _____
C. _____
D. _____
E. _____
F. _____
G. _____
H. _____
I. _____
J. _____
K. _____

Name _____

SWITCHES (Continued)

16. Which of the following types of switches has a spring-loaded button that, when pressed, makes or breaks an electrical connection across two contacts?
    a. Toggle switch.
    b. Push-button switch.
    c. Thermal switch.
    d. Pressure switch.

CAPACITORS

17. Identify the item below. Give its symbol, letter designation, and describe its purpose.

Item: _____

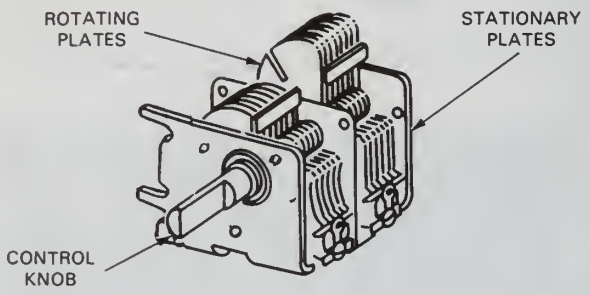
Symbol: _____

Letter designation: _____

Purpose: _____

_____

18. Identify the item below. Give its symbol, letter designation, and describe its purpose.



(Kelvin Electronics)

Item: _____

Symbol: _____

Letter designation: _____

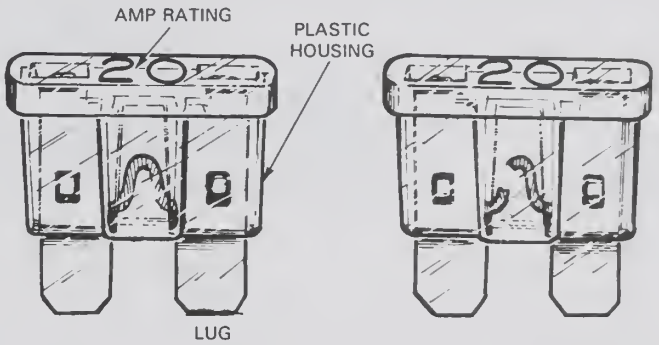
Purpose: _____

_____

Name _____

FUSES

19. Identify the item below. Give its symbol, letter designation, and describe its purpose.



(Buick)

Item: _____

Symbol: _____

Letter designation: _____

Purpose: _____

_____

20. List three basic types of fuses.

_____

_____

_____

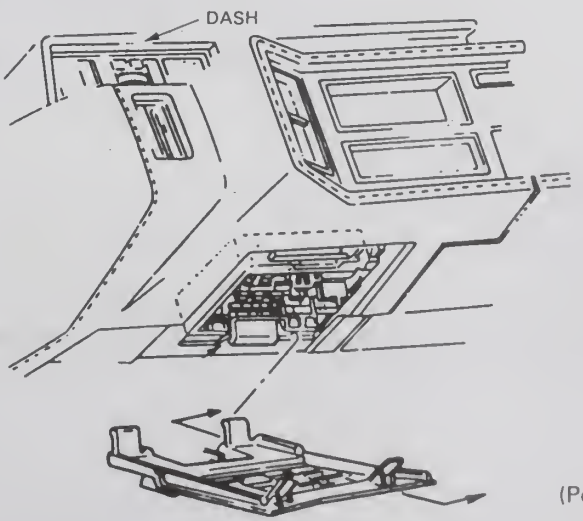
21. A fuse rating is given in:
    a. Amps.
    b. Volts.
    c. Ohms.
    d. None of the above.

22. When replacing a fuse, why should you always install a fuse with the same amp rating?

_____

23. What is indicated in the drawing below? _____

_____

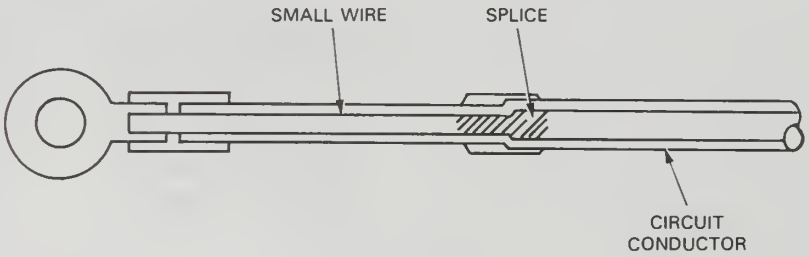


(Pontiac)

Name _____

FUSES (Continued)

24. Identify the item below. Give its symbol, letter designation, and describe its purpose.



(Ford)

Item: _____

Symbol: _____

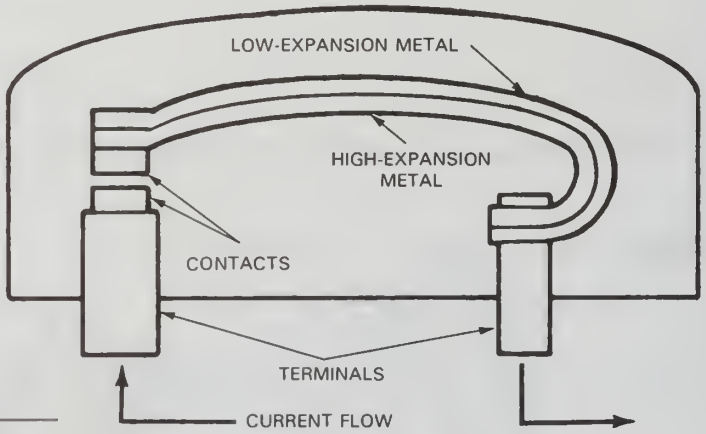
Letter designation: _____

Purpose: _____

_____

CIRCUIT BREAKERS

25. Identify the item below. Give its symbol, letter designation, and describe its purpose.



Item: _____

Symbol: _____

Letter designation: _____

Purpose: _____

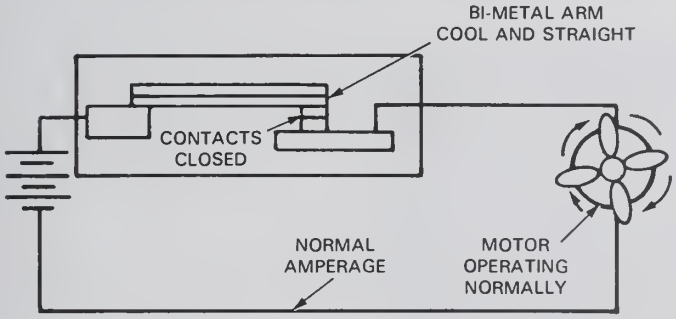
_____

26. True or false? To avoid an electrical fire, install circuit breakers with a higher amp rating than specified.

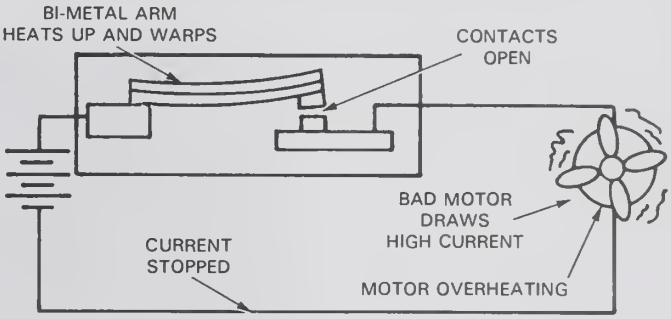
Name _____

CIRCUIT BREAKERS (Continued)

27. Describe what is happening in the diagrams of circuit breaker action below.



A



B

A. _____

_____

B. _____

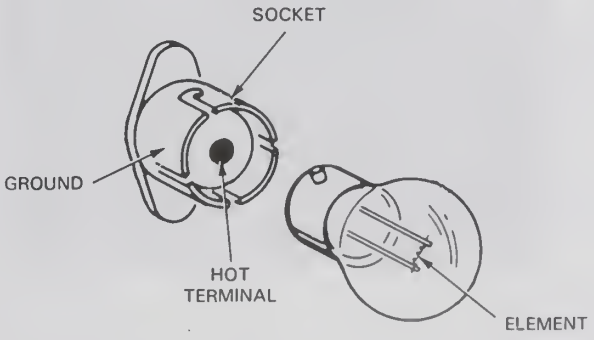
_____

FLASHERS

28. A(n) _____ is similar to a circuit breaker, but it is designed to open and close the circuit at a constant rate.

LIGHT BULBS

29. Identify the item below. Give its symbol, letter designation, and describe its purpose.



(Fiat)

Item: _____

Symbol: _____

Letter designation: _____

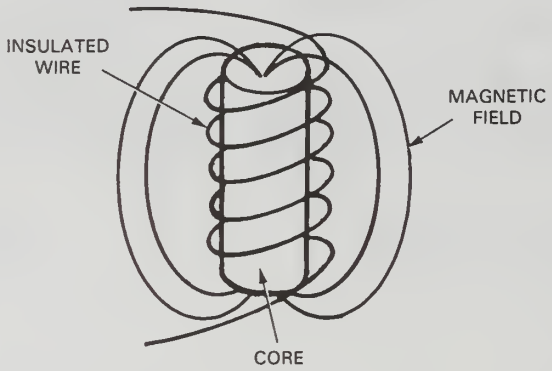
Purpose: _____

_____

Name _____

COILS

30. Identify the item below. Give its symbols and describe its purpose.



Item: _____

Symbols: _____ _____

Purpose: _____

_____

TRANSFORMERS

31. Identify the item below. Give its symbol, letter designation, and describe its purpose.

Item: _____

Symbol: _____

Letter designation: _____

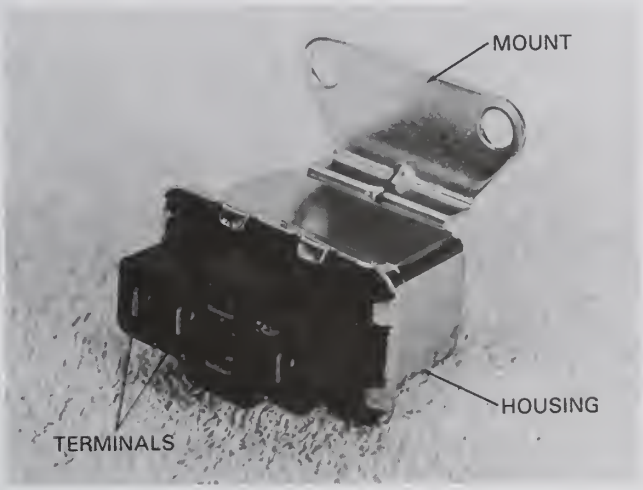
Purpose: _____

_____

Name _____

RELAYS

32. Identify the item below. Give its symbol, letter designation, and describe its purpose.



(Universal Auto Supply)

Item: _____

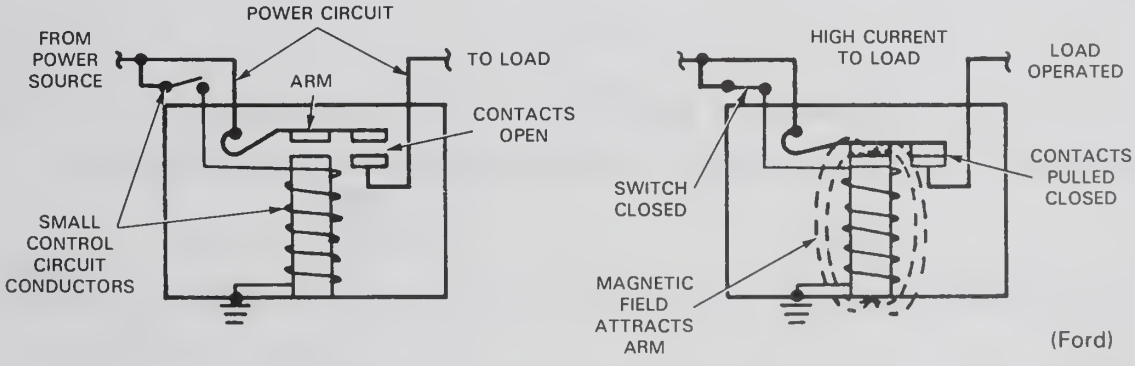
Symbol: _____

Letter designation: _____

Purpose: _____

_____

33. Describe what is happening in the diagrams of relay action below.



A B

A. _____

_____

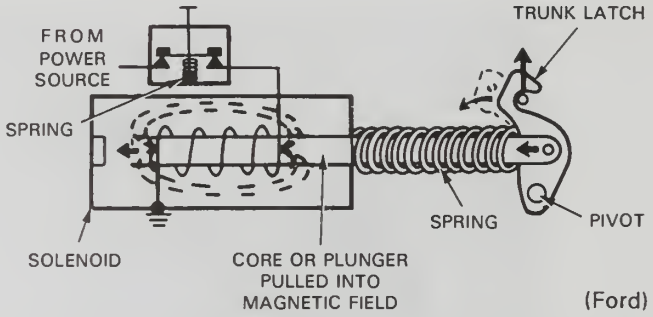
B. _____

_____

Name _____

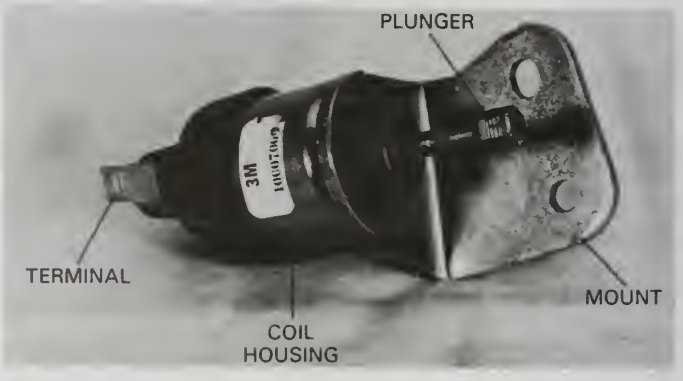
SOLENOIDS

34. The illustration below is an example of how a(n) _____ can convert electrical energy into motion or work.



(Ford)

35. Identify the item below. Give its symbol, letter designation, and describe its purpose.



(Universal Auto Supply)

Item: _____

Symbol: _____

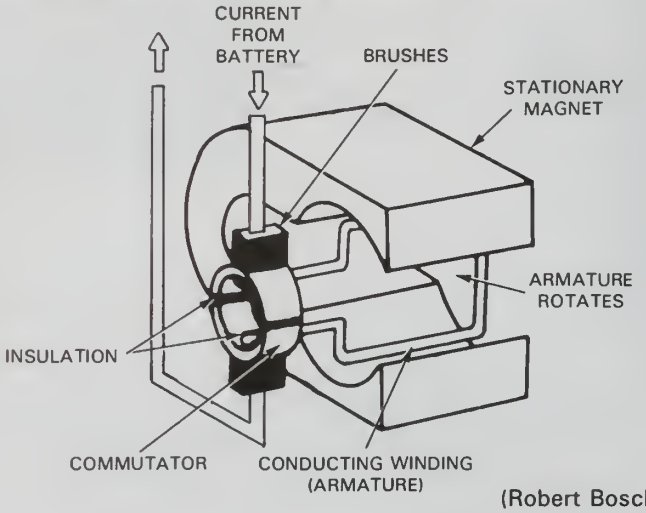
Letter designation: _____

Purpose: _____

_____

MOTORS

36. Identify the item below. Give its symbol, letter designation, and describe its purpose.



(Robert Bosch)

Item: _____

Symbol: _____

Letter designation: _____

Purpose: _____

_____

Chapter 5

ELECTRONIC PRINCIPLES, COMPONENTS, AND DIGITAL LOGIC

Name _____

Date _____ Period _____

Instructor _____

OBJECTIVE: After studying this chapter, you will be able to describe electronic principles and digital logic. You will also be able to identify electronic components.

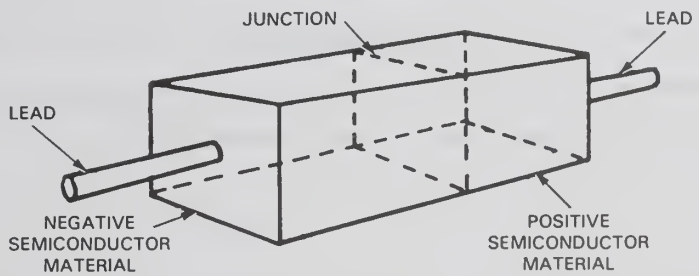
INSTRUCTIONS: As you study the text, complete the workbook problems.

SEMICONDUCTORS

1. True or false? The terms electronic or solid state refer to components that use moving parts.
2. A(n) _____ is a crystal material that can act as both a conductor or an insulator.
3. A P-type semiconductor is a more _____ (negative, positive) substance, while an N-type semiconductor is a more _____ (negative, positive) substance.

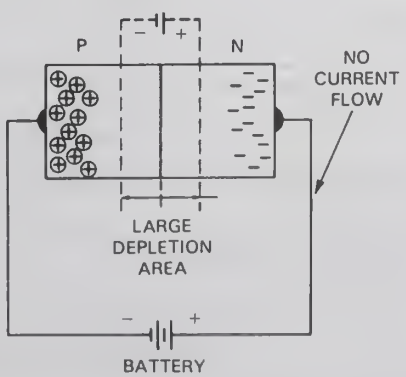
DIODES

4. Identify the item shown below and describe its purpose. _____

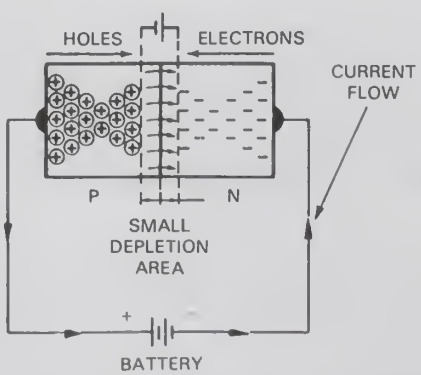


5. Look at the illustrations below. Indicate which one is a forward biased diode and which is a reverse biased diode.

A



B

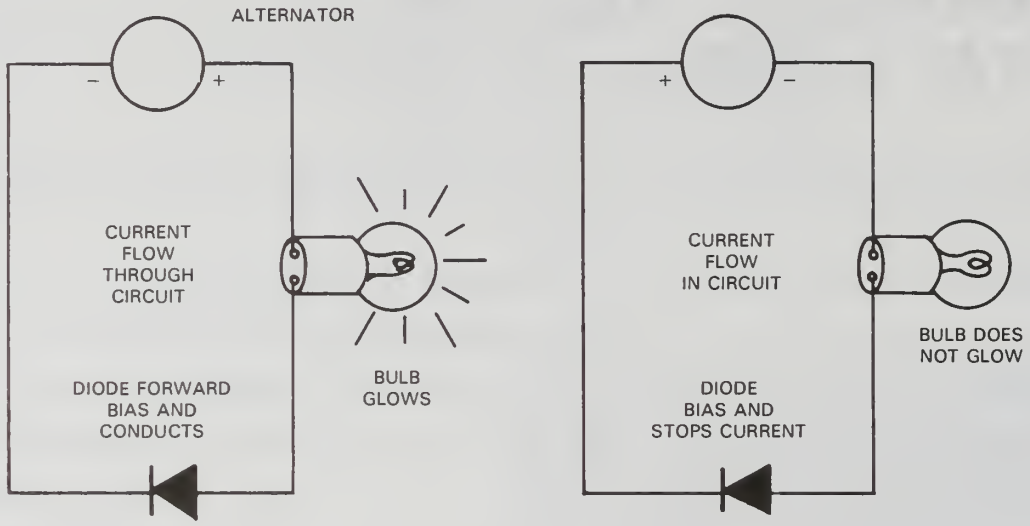


A. _____ B. _____

Name _____

DIODES (Continued)

6. _____ refers to changing AC into DC.
7. In the diagrams below, use arrows to indicate current flow.

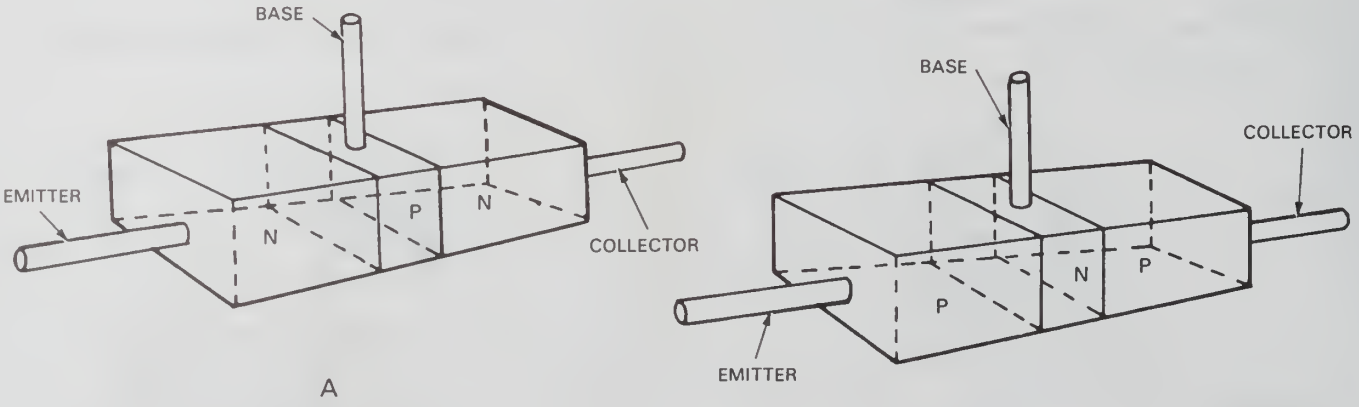


A B

8. True or false? The AC must be rectified into DC for use in an automobile's electrical system.
9. A(n) _____ diode is a special diode that serves as a voltage (pressure) relief valve.

TRANSISTORS

10. True or false? A transistor is a semiconductor device for switching or amplifying current in a circuit.
11. Identify the types of transistors shown in the diagrams below.



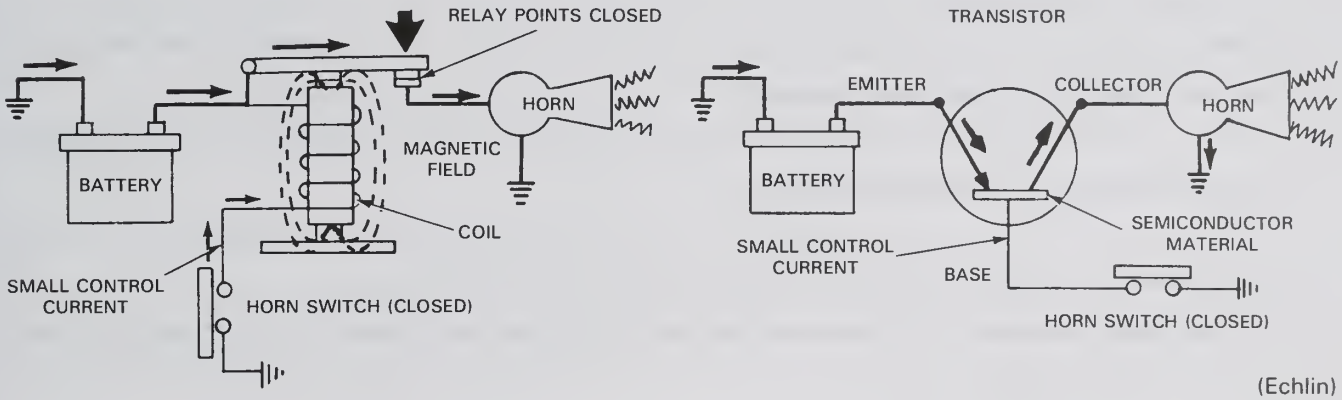
A B

A. _____ B. _____

Name _____

TRANSISTORS (Continued)

12. Explain what is happening in the illustrations below.



(Echlin)

A B

A. _____

_____

_____

B. _____

_____

_____

13. List four types of transistors and describe them.

_____

_____

_____

_____

_____

_____

_____

_____

THYRISTORS

14. True or false? A thyristor is a controllable diode that can only be used as a switch since it is either on or off.
15. True or false? A silicon controlled rectifier works like a transistor switch, but cannot amplify current.

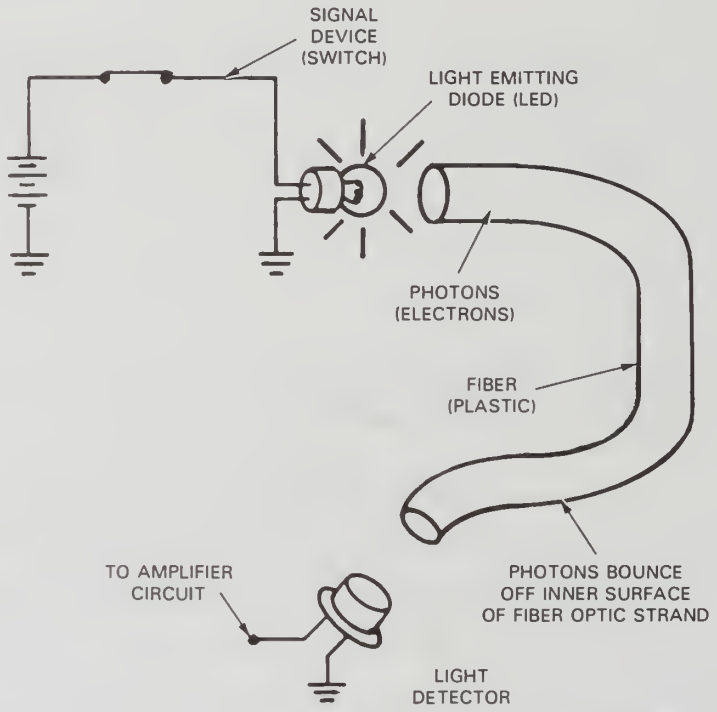
HALL-EFFECT CHIP

16. A hall-effect chip is a semiconductor device that can produce a small signal voltage or current when acted upon by a(n) _____ _____.
17. A(n) _____ crystal uses physical pressure to produce a small current output.

Name _____

PHOTONIC SEMICONDUCTORS

18. Photonic semiconductor is a classification of devices that can emit or detect _____.
19. A(n) _____ _____ _____ is a semiconductor that will emit light when electrically energized.
20. A(n) _____ is a semiconductor that acts as a resistor when in the dark, but changes to a conductor when exposed to light.
21. _____ _____ is a field of electronics that uses light flowing through small strands of plastic or glass to send electrical information.
22. On the diagram below, use arrows and lines to indicate the flow of flashing light through a strand of fiber optic material.



23. A(n) _____ _____ is a photonic device that will convert light directly into DC electricity.
24. A(n) _____ will become a small source of current when excited by light, and it can also be used to control current.
25. True or false? A phototransistor might be used in an automatic headlight dimming system.
26. A(n) _____ _____ _____ uses a fluid crystal material sandwiched between two sealed glass plates.
27. A(n) _____ _____ _____ generates light images by shooting electrons onto a phosphor material.

Name _____

PULSES, WAVES, SIGNALS NOISE

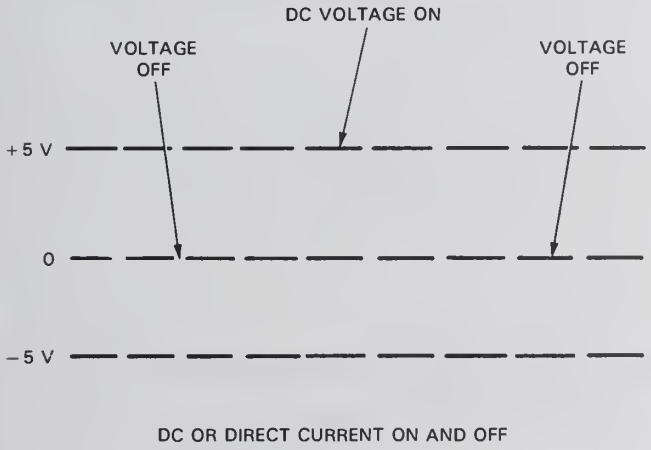
28. Match the following terms with their descriptions.

_____ 1. Pulse.
_____ 2. Wave.
_____ 3. Signal.
_____ 4. Noise.

a. A specific arrangement of pulses or waves that carries electronic data or information.
b. A gradual increase or decrease in voltage and current over a length of time.
c. A sudden increase or decrease in voltage or current.
d. An unwanted voltage fluctuation in a circuit.

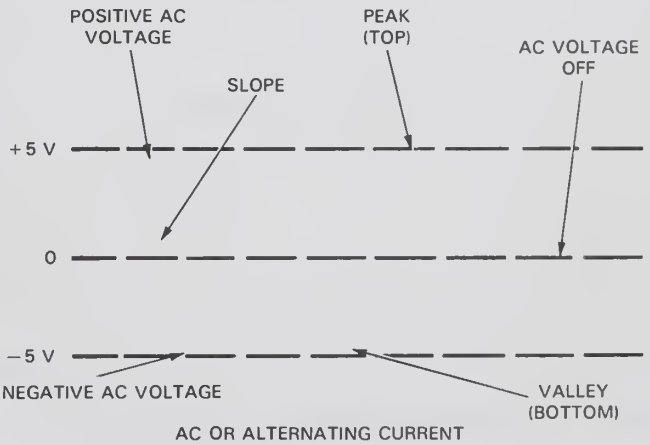
29. Draw lines below to indicate voltages in a square wave and sine or analog wave.

Square wave:



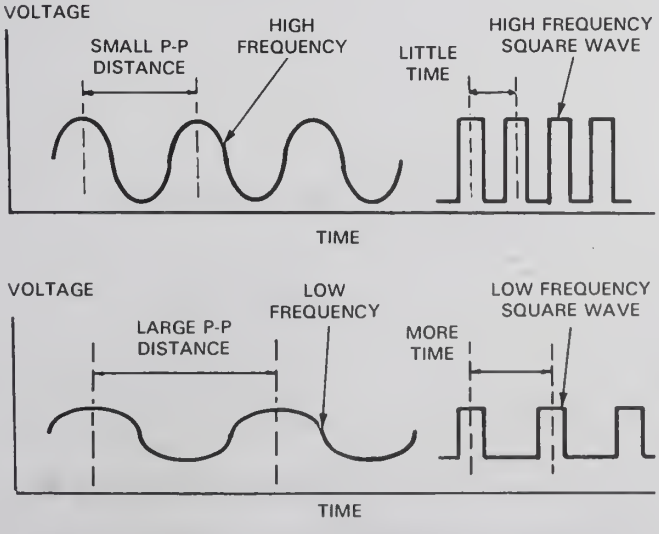
DC OR DIRECT CURRENT ON AND OFF

Sine or analog wave:

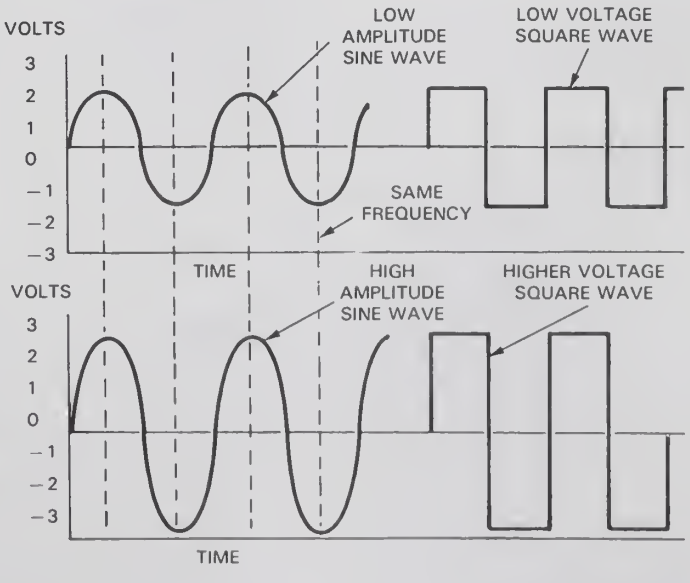


AC OR ALTERNATING CURRENT

30. Look at the illustrations below of how wave or pulse-voltage can vary. The taller a wave or pulse, the _____ (higher, lower) its voltage will be.



A



B

Name _____

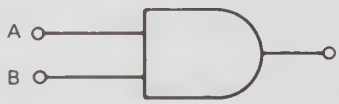
DIGITAL ELECTRONICS

31. A computer uses "artificial intelligence" by:
    a. Analyzing inputs or signals from sensors.
    b. Using memory.
    c. Making logical decisions on how to control specific outputs using the inputs.
    d. All of the above.
32. The _____ numbering system uses only two numbers and is the key to digital electronics and computers.
33. A(n) _____ is an electronic circuit that produces a specific output for a given input.
34. Identify the types of gates shown below.

A. _____
B. _____
C. _____
D. _____
E. _____

A	$\overline{A}$
1	0
0	1

A

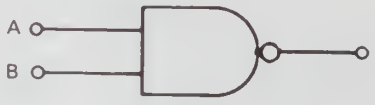


A	B	A • B
0	0	0
0	1	0
1	0	0
1	1	1

B

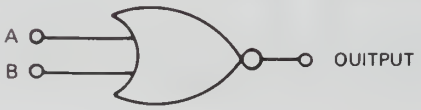
A	B	A + B
0	0	0
0	1	1
1	0	1
1	1	1

D



A	B	$\overline{A \bullet B}$
0	0	1
0	1	1
1	0	1
1	1	0

C



A	B	$\overline{A + B}$
0	0	1
0	1	0
1	0	0
1	1	0

E

(General Motors Corporation)

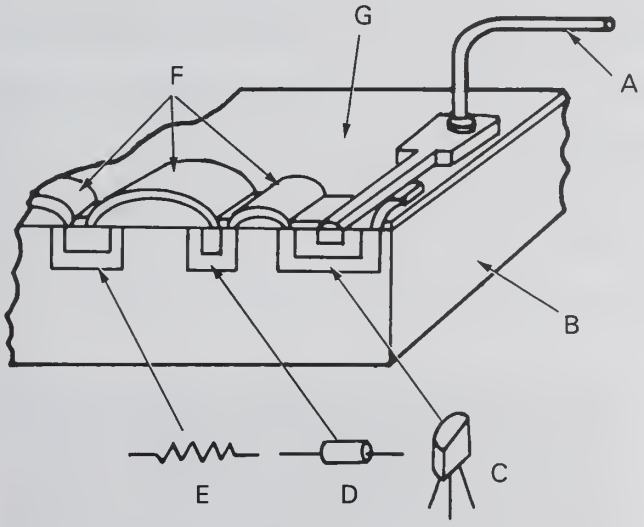
35. A(n) _____ _____ is a chart that shows what the outut of a gate will be with different inputs.

Name _____

INTEGRATED CIRCUIT

36. True or false? An integrated circuit is an electronic circuit that has been reduced in size and placed on the surface of a tiny semiconductor chip.

37. Identify the parts indicated on this microscopic section of an IC chip.



A. _____
B. _____
C. _____
D. _____
E. _____
F. _____
G. _____

38. Match the following terms with their descriptions.

_____ 1. Digital IC.
_____ 2. Analog IC.
_____ 3. Passive IC.
_____ 4. DIP.
_____ 5. SIP.

a. An integrated circuit containing complete amplifier circuits.
b. An integrated circuit with a single row of in-line pins or terminals.
c. An integrated circuit containing logic circuits.
d. An IC that cannot change its output response from its original inputs.
e. An integrated circuit with dual in-line pins.

Chapter 6

TOOLS AND TEST EQUIPMENT

Name _____

Date _____ Period _____

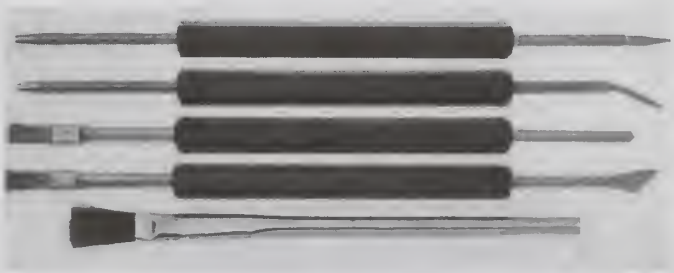
Instructor _____

OBJECTIVE: After studying this chapter, you will be able to identify and describe various types of tools and test equipment used in electrical repairs.

INSTRUCTIONS: As you study the text, complete the workbook problems.

SOLDERING TOOLS

1. True or false? Soldering provides the best method for making a permanent electrical connection.
2. _____ is a mixture of lead and tin.
3. through 10. Identify the soldering equipment below and briefly describe their use(s).



(Easco-KD Tools)

3. _____

_____

_____

4. _____

_____

_____

5. _____

_____

_____

6. _____

_____

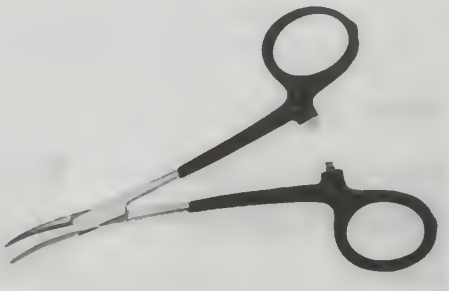
_____

Name _____

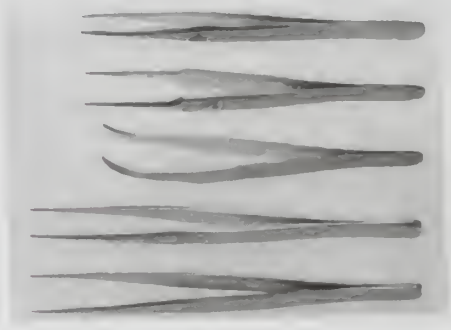
SOLDERING TOOLS (Continued)

(Easco-KD Tools)

7. _____
_____
_____



8. _____
_____
_____



9. _____
_____
_____

(Easco-KD Tools)

10. _____
_____
_____

Name _____

WIRE STRIPPING TOOLS, PLIERS

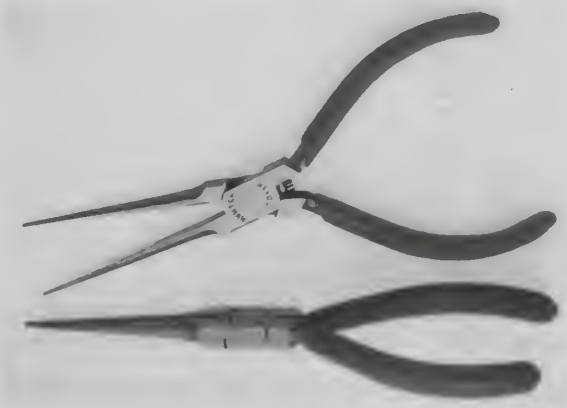
11. through 15. Identify the wire striping tools and pliers below and briefly describe their use(s).

11. _____
_____
_____

12. _____
_____
_____

13. _____
_____
_____

14. _____
_____
_____



(Easco-KD Tools)

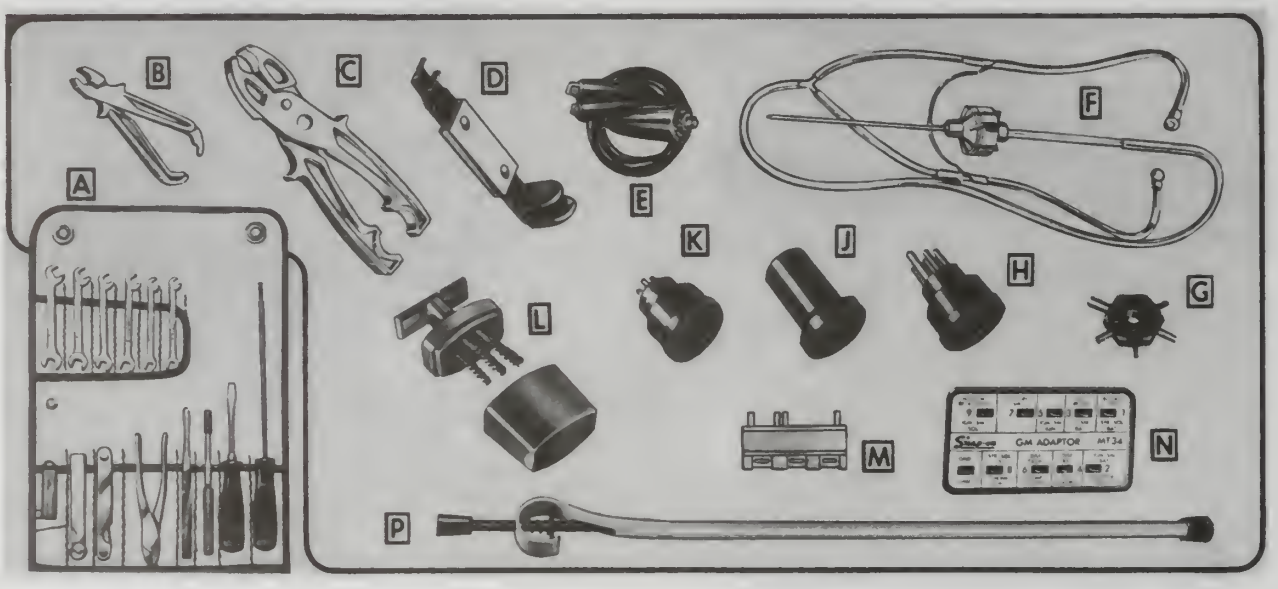
15. _____
_____
_____

Name _____

OTHER TOOLS

16. In electrical repair, special _____ are needed for working with very small fasteners.

17. Identify the items shown below.



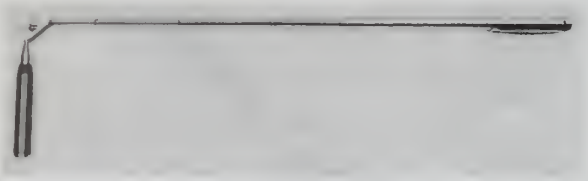
(Snap-on Tools)

A. _____
B. _____
C. _____
D. _____
E. _____
F. _____
G. _____
H. _____
J. _____
K. _____
L. _____
M. _____
N. _____
P. _____

18. Identify the tool below and describe its use.

_____
_____
_____

19. Identify the tool below and describe its use.



_____
_____
_____

Name _____

ELECTRICAL TEST EQUIPMENT

20. through 28. Identify the electrical test equipment below and briefly describe their use(s).

20. _____

_____

_____

21. _____

_____

_____

(TIF)

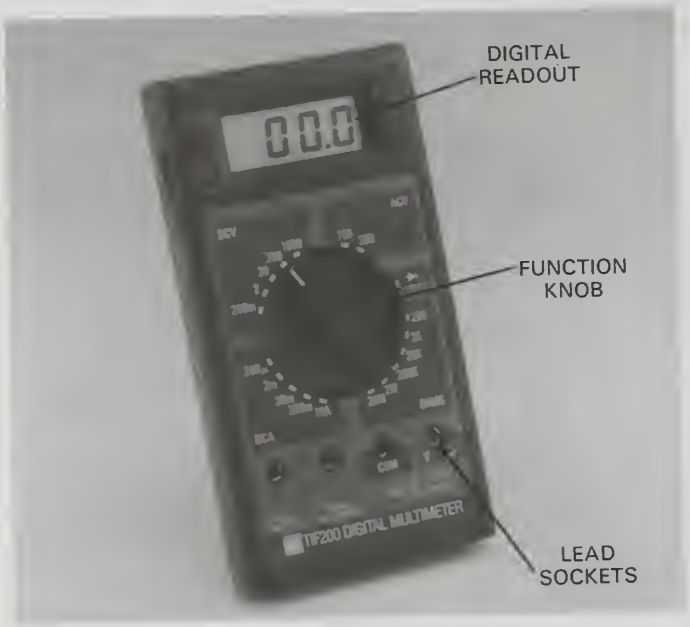
22. _____

_____

_____

Name _____

ELECTRICAL TEST EQUIPMENT (Continued)



(TIF)

23. _____

_____

_____

24. _____

_____

_____

(TIF)

25. _____

_____

_____

Name _____

ELECTRICAL TEST EQUIPMENT (Continued)

(TIF)

(TIF)

26. _____

_____

_____

_____

27. _____

_____

_____

_____

(TIF)

28. _____

_____

_____

Name _____

BATTERY CHARGING, STARTING SYSTEM SERVICE TOOLS

29. Identify the battery-related service tools shown below.

(Snap-on Tools)

A. _____
B. _____
C. _____
D. _____
E. _____
F. _____
G. _____
H. _____
I. _____
J. _____

K. _____
L. _____
M. _____
N. _____
O. _____
P. _____
Q. _____
R. _____
S. _____

Name _____

BATTERY CHARGING, STARTING SYSTEM SERVICE TOOLS (Continued)

30. through 34. Identify the battery service tools below and briefly describe their use(s).

(TIF)

30. _____

_____

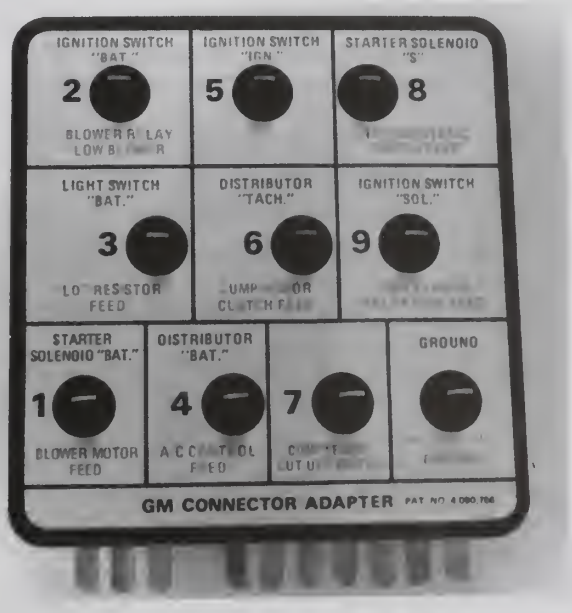
_____

(Snap-on Tools)

31. _____

_____

_____



(Hennessy Industries)

32. _____

_____

_____

(Sun Electric)

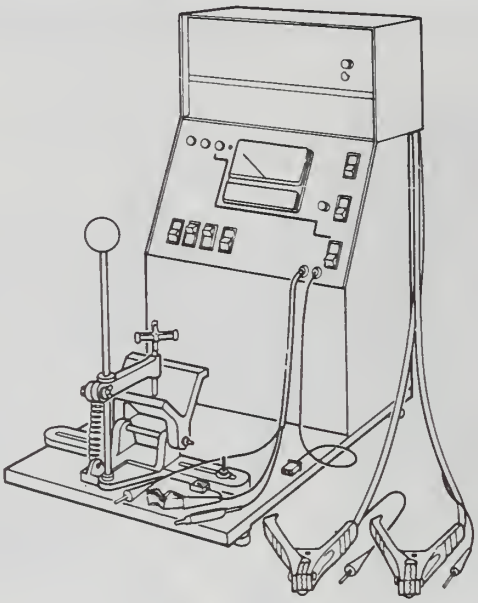
33. _____

_____

_____

Name _____

BATTERY CHARGING, STARTING SYSTEM SERVICE TOOLS (Continued)



(Champion Parts Rebuilders)

34. _____

_____

_____

IGNITION SYSTEM TEST EQUIPMENT

35. through 41. Identify the ignition system test equipment below and briefly describe their use(s).

(TIF)

35. _____

_____

_____

36. _____

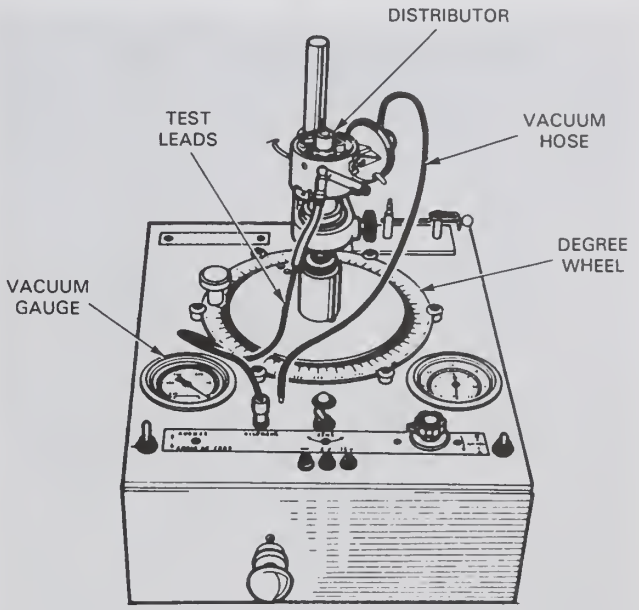
_____

_____

Name _____

IGNITION SYSTEM TEST EQUIPMENT (Continued)

(Sonco)



(Renault)

37. _____

_____

_____

38. _____

_____

_____

(Belden)

39. _____

_____

_____

Name _____

IGNITION SYSTEM TEST EQUIPMENT (Continued)

(Fox Valley)

(Peerless)

40. _____

_____

_____

41. _____

_____

_____

EXHAUST GAS ANALYZER

42. Identify the item below and briefly describe its use(s).

(Snap-on Tools)

42. _____

_____

_____

Name _____

DIESEL SERVICE TOOLS

43. True or false? A diesel engine uses an electrical ignition system.

44. Describe the uses of the equipment shown below.

(OTC)

(OTC)

A. _____

_____

_____

B. _____

_____

_____

COMPUTER SYSTEM TESTERS

45. through 49. Identify the computer system testing equipment below and briefly describe their use(s).

(Autodata)

45. _____

_____

_____

(TIF)

46. _____

_____

_____

(Sun Electric)

47. _____

_____

_____

(Sun Electric)

48. _____

_____

_____

(Sun Electric)

49. _____

_____

_____

Name _____

COMPUTER SYSTEM TESTERS (Continued)

50. A computer system tester is needed to check the operation of:
    a. Vehicle sensors and actuators.
    b. Vehicle wiring.
    c. The computer itself.
    d. All of the above.

Chapter 7

WIRING, WIRING REPAIRS

Name _____

Date _____ Period _____

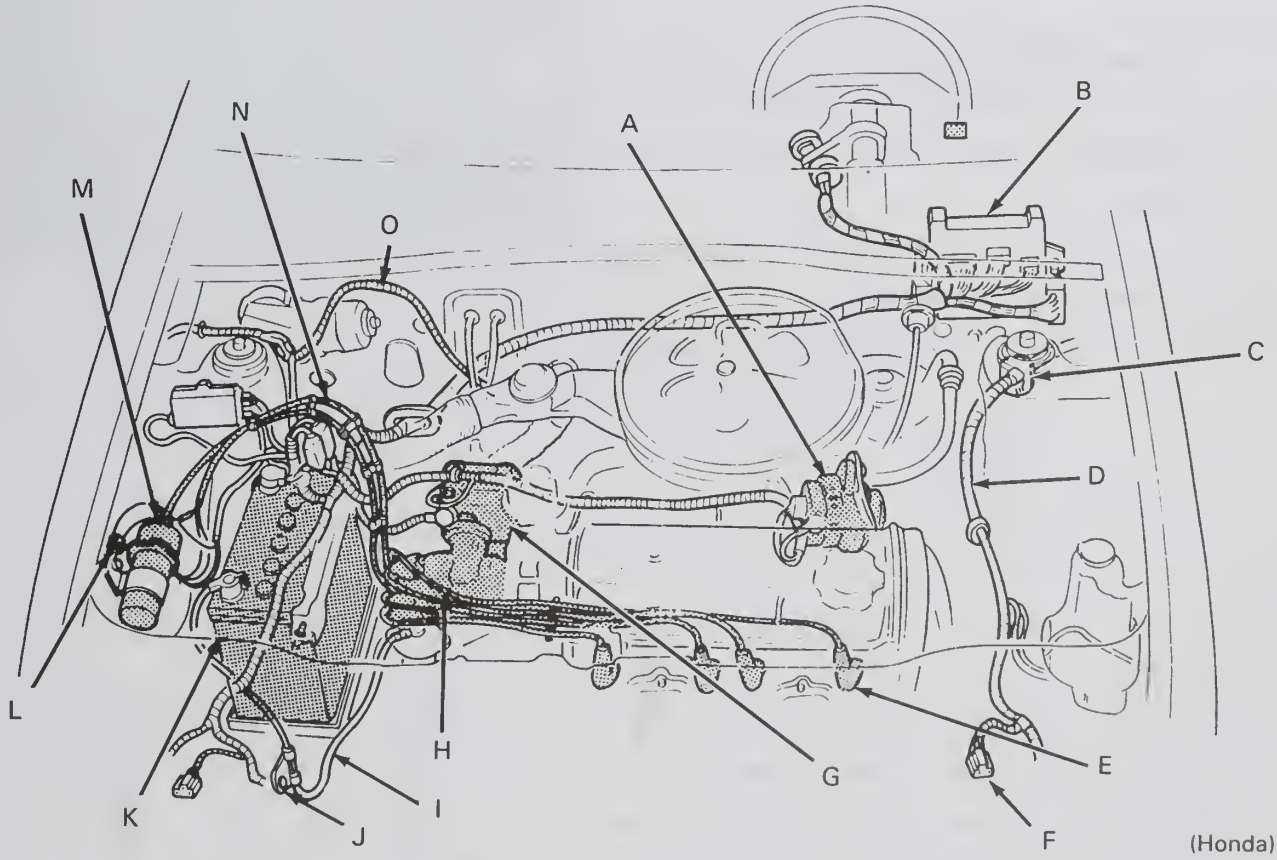
Instructor _____

OBJECTIVE: After studying this chapter, you will be able to identify various wire types and sizes and describe and make wiring repairs on cars.

INSTRUCTIONS: As you study the text, complete the workbook problems.

AUTOMOTIVE WIRING

1. Identify the various parts indicated on the illustration below.



(Honda)

A. _____

B. _____

C. _____

D. _____

E. _____

F. _____

G. _____

H. _____

I. _____

J. _____

K. _____

L. _____

M. _____

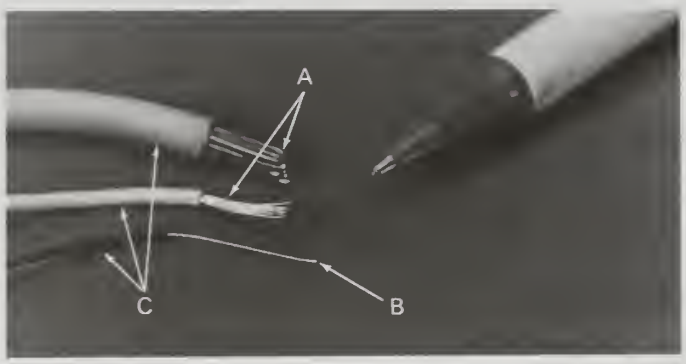
N. _____

O. _____

Name _____

AUTOMOTIVE WIRING (Continued)

2. Identify the types of wires shown below.



A. _____

B. _____

C. _____

3. Wire size:
   a. Is determined by the diameter of the conductor.
   b. Includes the thickness or diameter of the insulator.
   c. Limits how much current a wire can carry without overheating.
   d. Both a and c.
4. True or false? A 12 gauge wire is smaller than a 14 gauge wire.
5. Car wiring is usually between _____ and _____ gauge.
6. In the chart below, list the AWG size in gauge size.

Metric wire size in mm²		AWG size in gauge size
.22	Smallest	
.5		
.8		
1.0		
2.0		
3.0		
5.0		
8.0		
13.0		
19.0		
32.0	Largest	

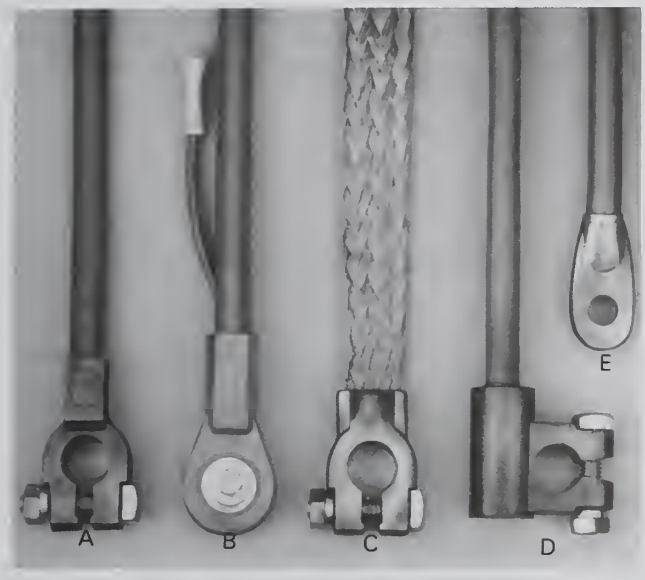
7. Wire resistance _____ (decreases, increases) as conductor diameter decreases.
8. _____ is dependent upon the material used in the conductor.
9. Resistance _____ (decreases, increases) as the length of the wire increases.
10. In most conductors, resistance _____ (decreases, increases) as temperature increases.
11. True or false? Excess current will heat a conductor and can melt or burn its insulation.
12. True or false? Always replace a wire with a different wire gauge size.

Name _____

AUTOMOTIVE WIRING (Continued)

13. _____ refer to huge wires that carry battery current to the starting motor and return current to the battery from ground.

14. Identify the battery cables shown in the photo below.



(Belden)

A. _____
B. _____
C. _____
D. _____
E. _____

15. What is the difference between primary and secondary wire?

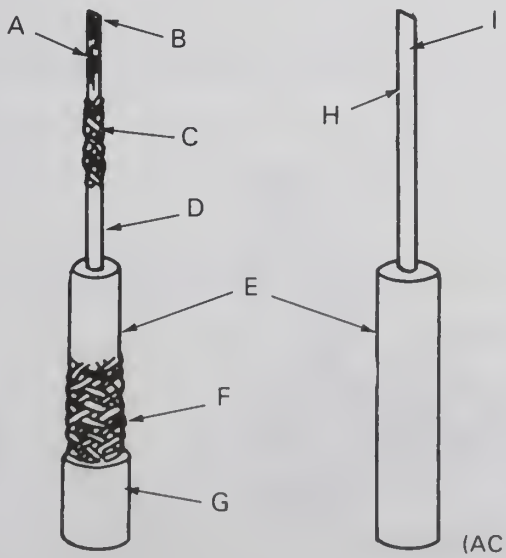
_____

_____

_____

_____

16. Identify the parts indicated on the secondary wire or spark plug wire below.



(AC Spark Plugs)

A. _____
B. _____
C. _____
D. _____
E. _____
F. _____
G. _____
H. _____
I. _____

Name _____

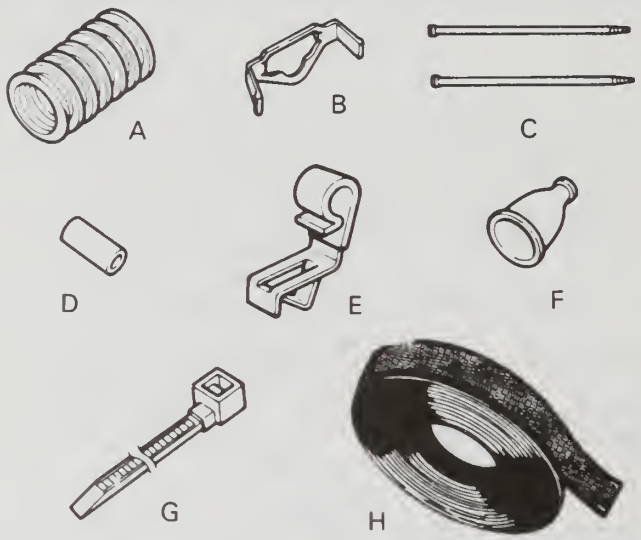
AUTOMOTIVE WIRING (Continued)

17. _____ wire has the center conductor surrounded by an outer metal shield.
18. _____ _____ wiring has copper foil bonded on a plastic or fiber base to form compact conductors.
19. Aluminum wire must be _____ (larger, smaller) in diameter to carry the same current as copper.
20. Why is color coding used on the insulation of wires? _____

_____

_____

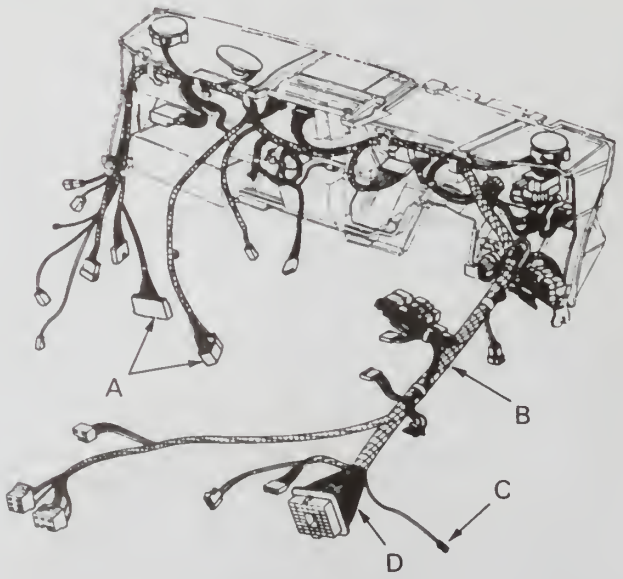
21. Identify the wire protection devices shown below.



A. _____
B. _____
C. _____
D. _____
E. _____
F. _____
G. _____
H. _____

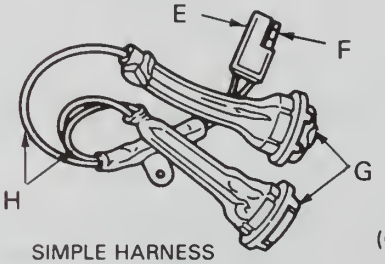
(Chrysler)

22. Identify the parts indicated on the wiring harnesses below.



COMPLEX HARNESS

A. _____
B. _____
C. _____
D. _____
E. _____
F. _____
G. _____
H. _____



SIMPLE HARNESS

(Chrysler)

Name _____

WIRING REPAIRS

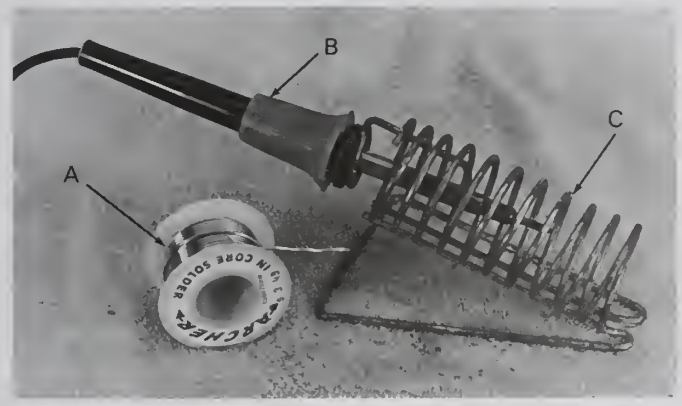
23. When cutting wire:
    a. Cut all the way through on the first try.
    b. Cut part way through, and then cut again.
    c. Always make a new cut when joining the wire to another component.
    d. Both a and c.
24. Why is it not recommended to strip off insulation using cutting pliers? _____

_____

_____

SOLDERING

25. Identify the items indicated in the photo below.



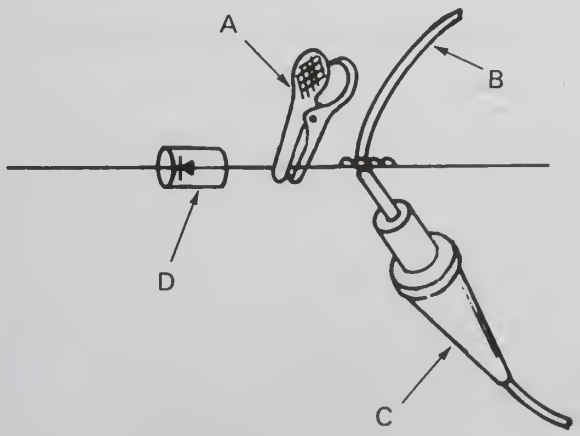
A. _____
B. _____
C. _____

26. _____ is done to clean and prepare the surface of the soldering gun tip and/or the electrical components by placing a thin coating of solder on the tip or parts.
27. Explain why electrical components must be preheated sufficiently before melting solder onto a joint.

_____

_____

28. Identify the items in the diagram below.



A. _____
B. _____
C. _____
D. _____

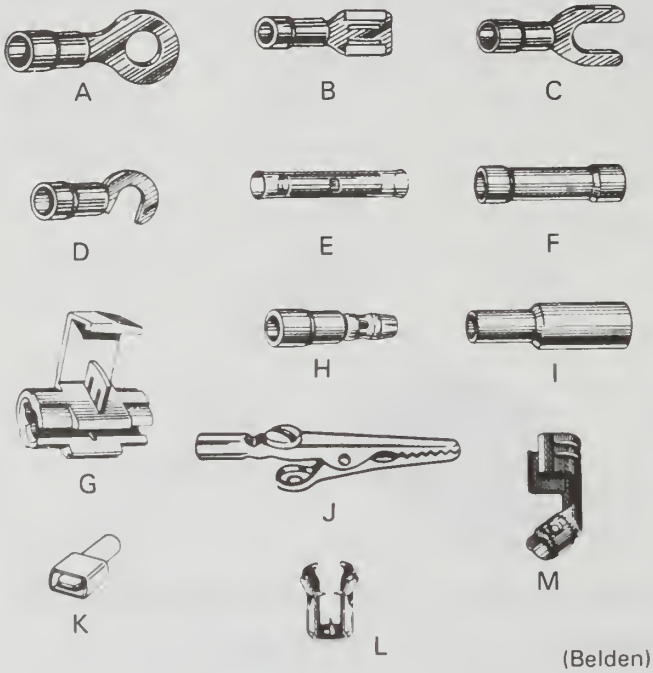
Name _____

SOLDERING (Continued)

29. Which of the following is the best choice to protect a conductor from moisture?
    a. Masking tape.
    b. Liquid electrical tape.
    c. Electrical tape.
    d. None of the above.

WIRE TERMINALS AND CONNECTORS

30. Identify the single wire connectors and terminals below.



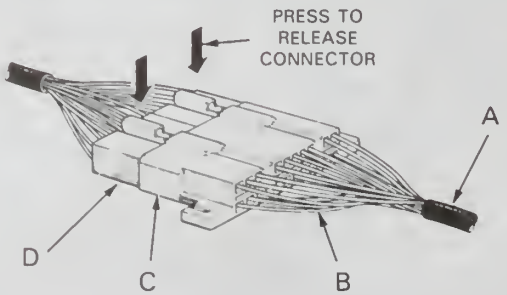
(Belden)

A. _____
B. _____
C. _____
D. _____
E. _____
F. _____
G. _____
H. _____
I. _____
J. _____
K. _____
L. _____
M. _____

31. True or false? If a wire were to pull out of a crimp connector, it could cause a short circuit.

FACTORY CONNECTORS

32. Identify the parts indicated on the factory connector below.



(Toyota)

A. _____
B. _____
C. _____
D. _____

33. Before refastening connectors, it is usually recommended that you apply _____ to the terminals to help prevent corrosion.

Name _____

FACTORY CONNECTORS

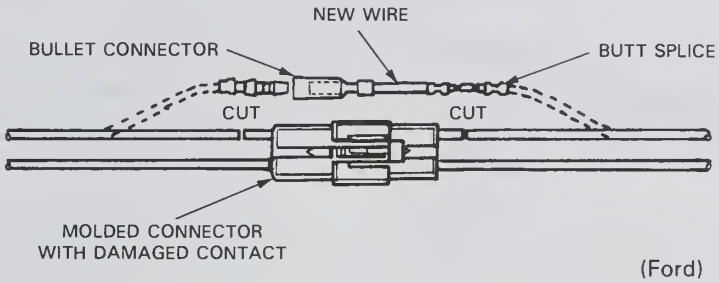
34. A(n) _____-_____ _____ will cut through the wire insulation and lock onto the wire conductor automatically.

WIRING REPAIRS

35. What has been done in the diagram below? _____

_____

_____

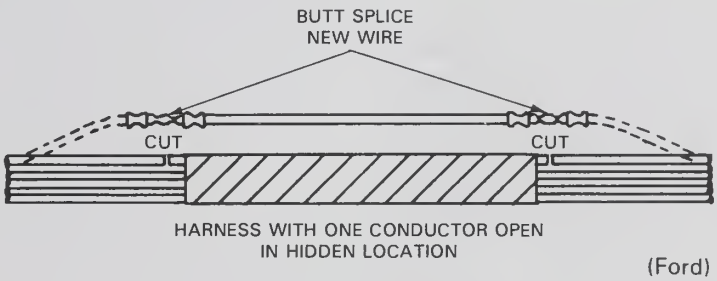


(Ford)

36. What has been done in the diagram below? _____

_____

_____



(Ford)

37. Before replacing a(n) _____ _____, correct the short circuit problem.

38. Describe the steps to take in replacing a fuse link. _____

_____

_____

_____

_____

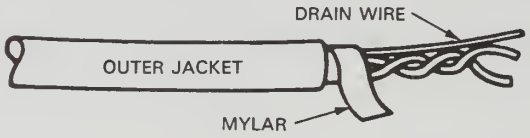
_____

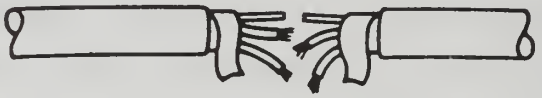
Name _____

WIRING REPAIRS (Continued)

39. List the six steps necessary for repairing twisted-shielded wire for a computer wiring harness.

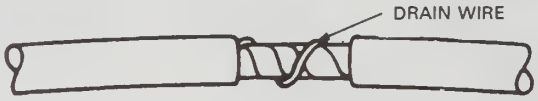
TWISTED/SHIELDED CABLE





1. _____
2. _____

3. _____
_____



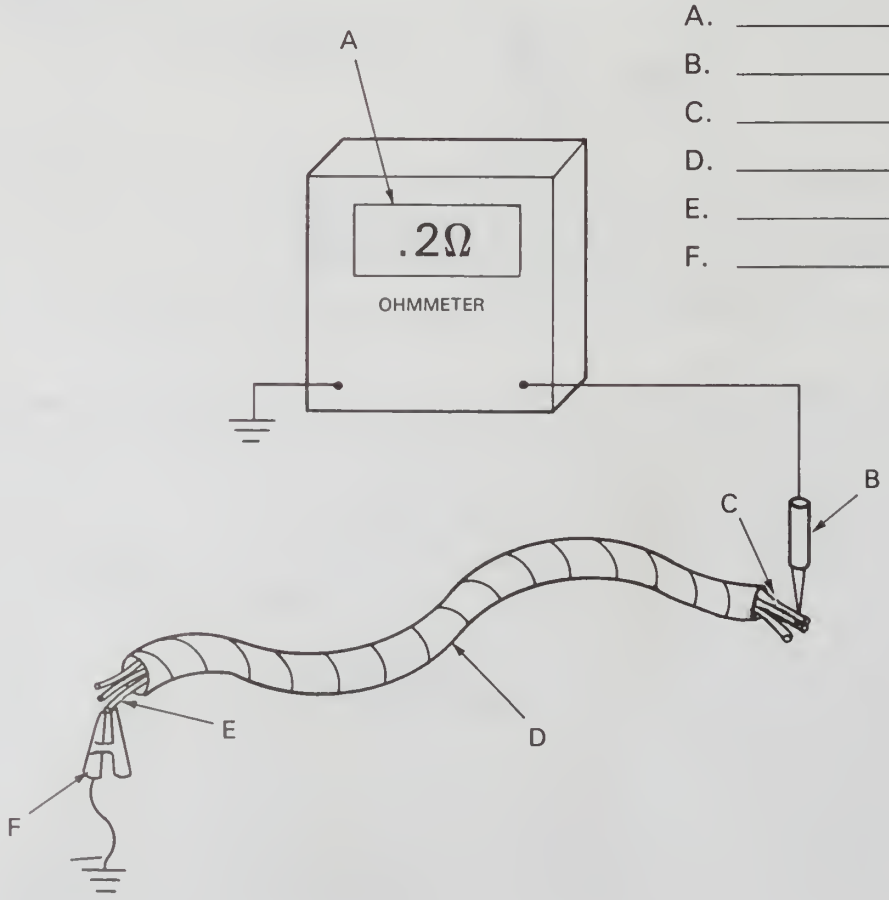
4. _____
_____
5. _____

6. _____

(General Motors)

40. Identify the items indicated in the basic harness wire test below.

A. _____
B. _____
C. _____
D. _____
E. _____
F. _____



Chapter 8

USING WIRING DIAGRAMS AND MANUALS

Name _____

Date _____ Period _____

Instructor _____

OBJECTIVE: After studying this chapter, you will be able to use service manuals and wiring diagrams to locate electrical components.

INSTRUCTIONS: As you study the text, complete the workbook problems.

USING SERVICE MANUALS

1. Identify the terms represented by the abbreviations often used in service manuals.

LIST OF AUTOMOTIVE ABBREVIATIONS

A/C— _____
ACCEL— _____
ADJ— _____
A/F— _____
AIR— _____
ALDL— _____
Alt— _____
AMP— _____
ANT— _____
APS— _____
ASM— _____
AT— _____
ATDC— _____
Auth— _____
Auto— _____

BARO— _____
Bat— _____
Bat+— _____
Bbl— _____
BCM— _____
BP— _____
BTDC— _____

°C— _____
Calif— _____
Cat. Conv.— _____
CCC— _____
CCOT— _____
CCP— _____
CID— _____
CL— _____
CLCC— _____
CO— _____
Coax— _____
Conn— _____
Conv— _____
CP— _____
CPS— _____
Crank— _____
CTS— _____
CV— _____
Cyl— _____
C³I— _____

DBM— _____
Diff— _____
DIS— _____
Dist— _____
DUM— _____
DVDV— _____

EAC— _____
EAS— _____
ECC— _____
ECM— _____
ECU— _____
EECS— _____
EFE— _____
EFI— _____
EGR— _____
EGR/TVS— _____
ELC— _____
ESC— _____
EST— _____
ETR— _____
EVRV— _____
EXH— _____

Name _____

USING SERVICE MANUALS (Continued)

LIST OF AUTOMOTIVE ABBREVIATIONS (Continued)

°F— _____
FED— _____
FWD— _____

GAL— _____
Gen— _____
Gov— _____
g— _____

Harn— _____
HC— _____
HD— _____
HEI— _____
Hg— _____
HiAlt— _____

IAC— _____
IC— _____
ID— _____
IGN— _____
ILC— _____
INJ— _____
IP— _____
IPC— _____
INT— _____

km— _____
km/h— _____
kPa— _____
KV— _____

L— _____
lbs.ft.— _____
lbs.in.— _____
LF— _____
LH— _____
LR— _____
LS— _____
L-4— _____

MAF— _____
MAN— _____

2. Which of the following gives logical steps for finding and correcting problems?
   a. Diagnosis or troubleshooting charts.
   b. Repairing procedures.
   c. Electrical specifications.
   d. References.
3. Why is it critical that you refer to electrical specifications when doing electrical repairs?

_____

_____

_____

_____

Name _____

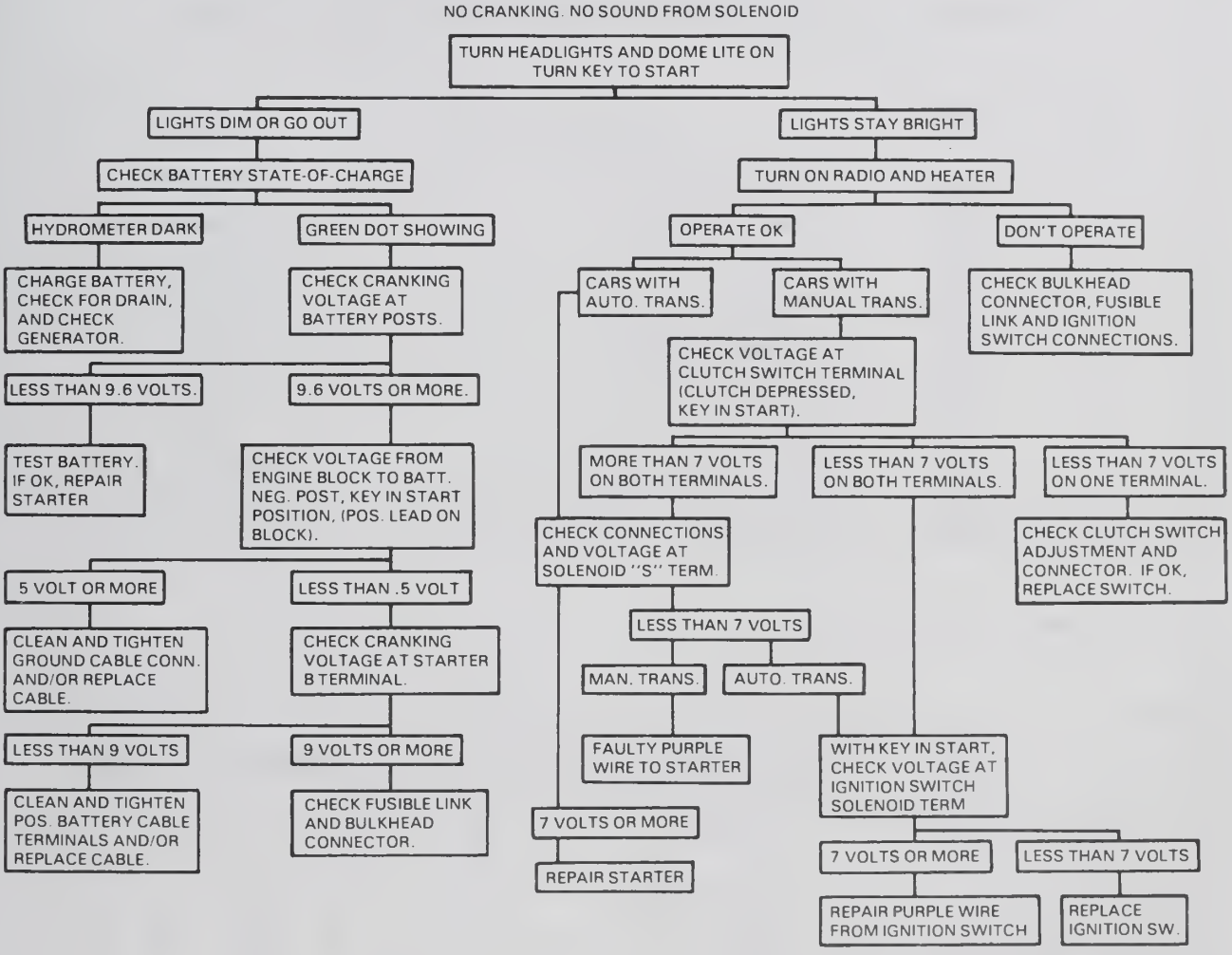
USING SERVICE MANUALS (Continued)

4. Look at the diagnosis chart below. Suppose that the headlights are dim or go out. You have checked the voltage from the engine block to the negative post of the battery with the key in the start position. There is .5 volt or more. What is the next step? _____

_____

_____

_____


NO CRANKING. NO SOUND FROM SOLENOID
TURN HEADLIGHTS AND DOME LITE ON TURN KEY TO START
LIGHTS DIM OR GO OUT
LIGHTS STAY BRIGHT
CHECK BATTERY STATE-OF-CHARGE
TURN ON RADIO AND HEATER
HYDROMETER DARK
GREEN DOT SHOWING
OPERATE OK
DON'T OPERATE
CHARGE BATTERY, CHECK FOR DRAIN, AND CHECK GENERATOR.
CHECK CRANKING VOLTAGE AT BATTERY POSTS.
CARS WITH AUTO. TRANS.
CARS WITH MANUAL TRANS.
CHECK BULKHEAD CONNECTOR, FUSIBLE LINK AND IGNITION SWITCH CONNECTIONS.
CHECK VOLTAGE AT CLUTCH SWITCH TERMINAL (CLUTCH DEPRESSED, KEY IN START).
LESS THAN 9.6 VOLTS.
9.6 VOLTS OR MORE.
TEST BATTERY. IF OK, REPAIR STARTER
CHECK VOLTAGE FROM ENGINE BLOCK TO BATT. NEG. POST, KEY IN START POSITION, (POS. LEAD ON BLOCK).
MORE THAN 7 VOLTS ON BOTH TERMINALS.
LESS THAN 7 VOLTS ON BOTH TERMINALS.
LESS THAN 7 VOLTS ON ONE TERMINAL.
CHECK CONNECTIONS AND VOLTAGE AT SOLENOID "S" TERM.
CHECK CLUTCH SWITCH ADJUSTMENT AND CONNECTOR. IF OK, REPLACE SWITCH.
5 VOLT OR MORE
LESS THAN .5 VOLT
LESS THAN 7 VOLTS
CLEAN AND TIGHTEN GROUND CABLE CONN. AND/OR REPLACE CABLE.
CHECK CRANKING VOLTAGE AT STARTER B TERMINAL.
MAN. TRANS.
AUTO. TRANS.
LESS THAN 9 VOLTS
9 VOLTS OR MORE
FAULTY PURPLE WIRE TO STARTER
WITH KEY IN START, CHECK VOLTAGE AT IGNITION SWITCH SOLENOID TERM
CLEAN AND TIGHTEN POS. BATTERY CABLE TERMINALS AND/OR REPLACE CABLE.
CHECK FUSIBLE LINK AND BULKHEAD CONNECTOR.
7 VOLTS OR MORE
REPAIR STARTER
7 VOLTS OR MORE
LESS THAN 7 VOLTS
REPAIR PURPLE WIRE FROM IGNITION SWITCH
REPLACE IGNITION SW.

(General Motors)

Name _____

COMPONENT LOCATIONS

5. Look at the relay and component location chart below. What data is given for the ignition mode relay? Also, locate it on the car by drawing a box around it.

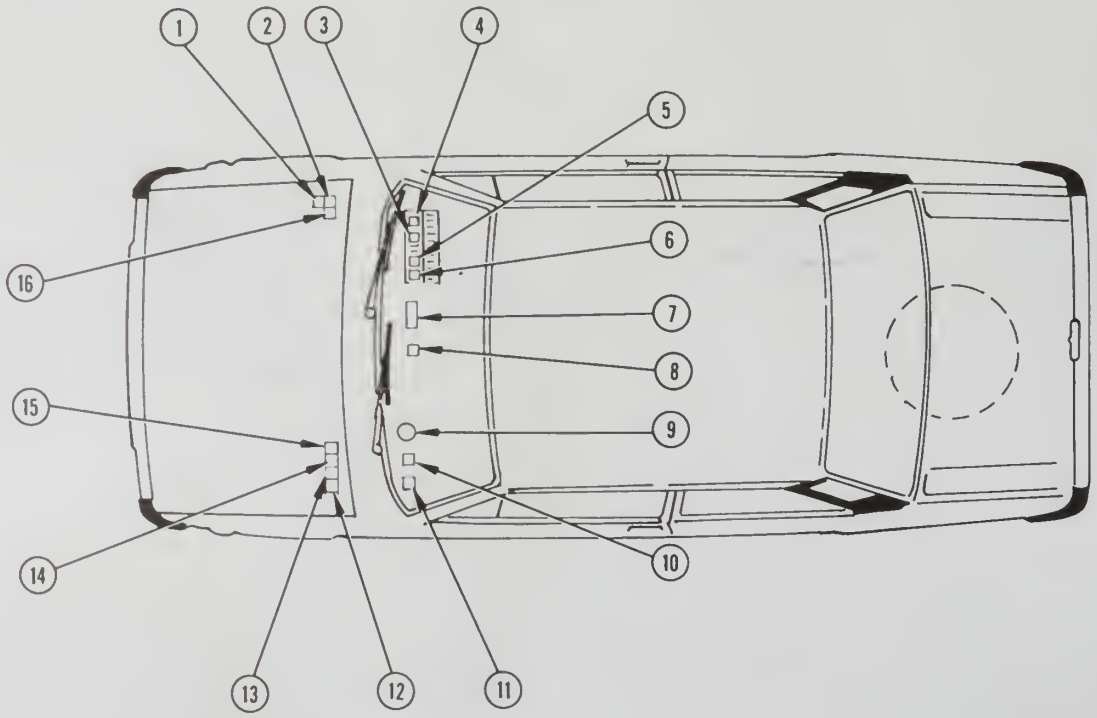
Chart No. _____

Component No. _____

Part No. _____

Relay and Component Location Chart

CHART NO.	COMPONENT NO.	DESCRIPTION	PART NO.
1	00611	A.C. fast idle relay	4320629-4337067
2	00615	A.C. condenser fan relay	4320629-4337067
3	00603	Engine fan operation relay	4320629-4320625-4337067
4	00702	Fuel pump relay (engine running)	4320627
5	00616	High beam relay	4320629-4337067
6	00605	Horns relay	4320629-4337067
7	06302	Seat belt indicator delay switch	4357723
8	00608	Rear window defogger relay	4320622-4337070-4339372
9	04302	Turn signal and hazard flasher	4347645
10	00609	Seat belt buzzer relay	4337070-4320622
11	05004	Fasten belts and remove key buzzer	4253302
12	00701	Ignition mode relay	4320627
13	00614	Fuel pump relay (engine starting)	4320629-4337067-4339372
14	00626	Diverter valve by-pass relay (standard transmission only)	4320626-4337068
15	00619	Starter relay (automatic transmission only)	4320629-4337067-4339372
16	00607	A.C. control relay	4320629-4337067

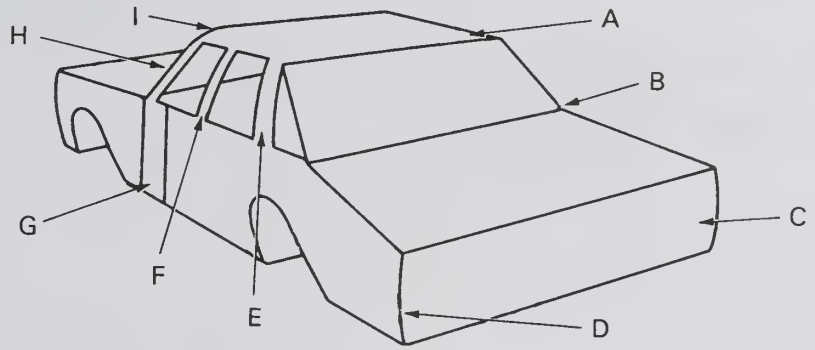


(Fiat)

Name _____

USING WIRING DIAGRAMS

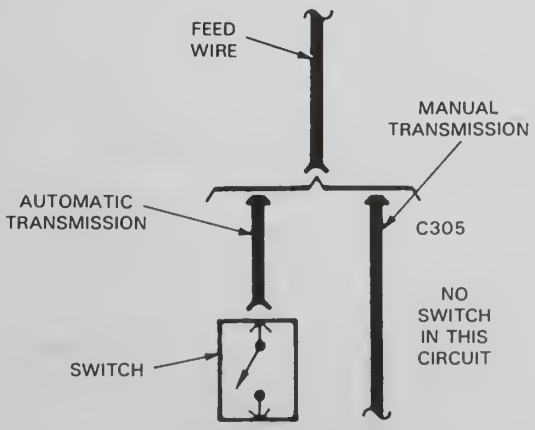
6. In wiring diagrams, symbols represent _____ and lines represent _____.
7. Identify the typical body parts indicated on the car below.



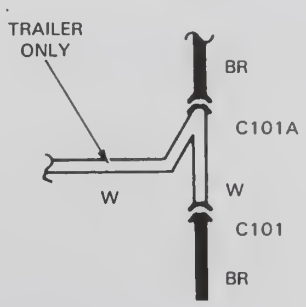
A. _____ F. _____
B. _____ G. _____
C. _____ H. _____
D. _____ I. _____
E. _____

8. The _____-_____ _____ _____ is a number-letter method for explaining the appearance, location, and gauge size of conductors on a wiring diagram.
9. A(n) _____ _____ _____ shows how major wiring is arranged and located in the car.
10. Wiring splices are normally shown on a wiring diagram by a(n) _____ where the wires connect.
11. _____ show where a circuit connects to the frame or chassis of a car.
12. Identify the types of diagrams below.

A. _____
B. _____



A



B

Name _____

USING WIRING DIAGRAMS (Continued)

13. A(n) _____ _____ is a terminal that allows several wires to connect together.
14. True or false? Connector diagrams show which connector terminals should be touched or tested when troubleshooting.
15. _____ _____ _____ are specifications given for voltage, current, and resistance for a known good circuit.
16. List eight tips for using wiring diagrams. _____

_____

_____

_____

_____

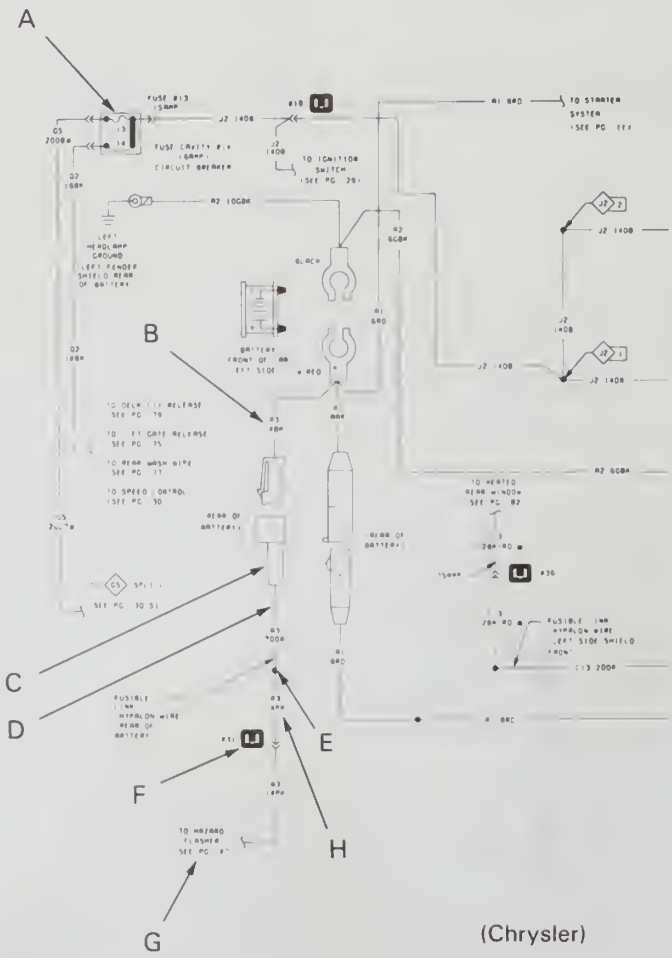
_____

_____

_____

_____

17. On the wiring diagram below, identify what the symbols and abbreviations mean.



(Chrysler)

A. _____

B. _____

C. _____

D. _____

E. _____

F. _____

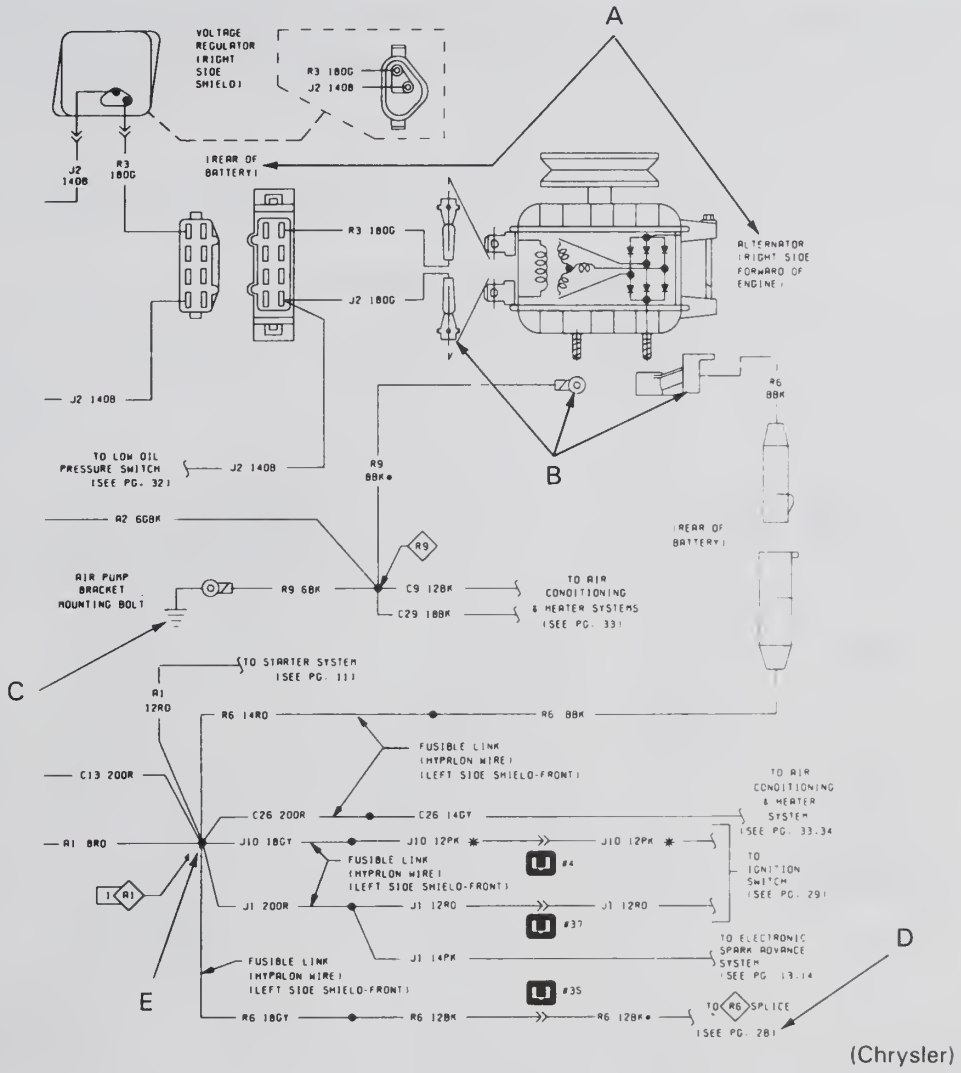
G. _____

H. _____

Name _____

USING WIRING DIAGRAMS (Continued)

18. On the wiring diagram below, identify what the symbols and abbreviations mean.



(Chrysler)

A. _____ D. _____

B. _____ E. _____

C. _____

19. A(n) _____ _____ _____ shows how battery current feeds to the main components or sections of the car's electrical system.

Name _____

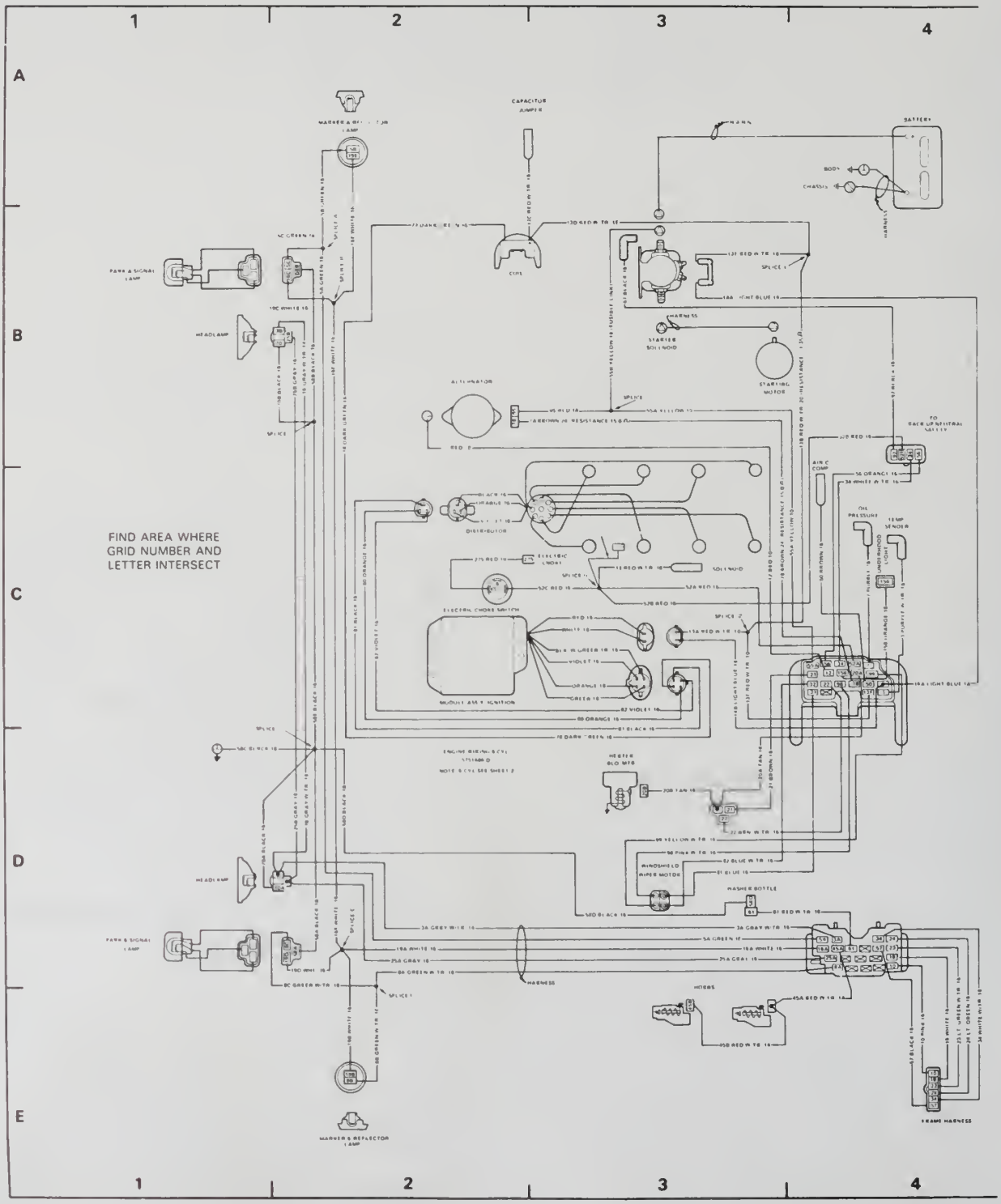
USING WIRING DIAGRAMS (Continued)

20. Using the location grid, what components are located in the area 3D? _____

_____

_____

_____



Name _____

USING WIRING DIAGRAMS (Continued)

21. A(n) _____ _____ _____ is a large diagram containing symbols for all major wiring and electrical-electronic components on a car.
22. True or false? A system wiring diagram only contains the components and wires for a particular circuit.
23. The _____ _____ uses simple boxes to show components and lines to show wires, hoses, or metal lines.

VACUUM DIAGRAM

24. If you were an electronic technician, why would you need to know how to work with vacuum diagrams? _____

_____

_____

25. Identify the typical vacuum component symbols below.

A CL BI MET	DIST	TK	VCKV
A CL CWM	EGR	TVS	VDV
A CL DV	VAC IVV	VAC SW	VOTM
ACV	MAN VAC	VCV 2-PORT	VRDV
ALT COMP	PURGE CV	VCV 3-PORT	VRESER
ANTI B F	SA-FV	VCV 4-PORT	VREST
CARB	SOL V		VVVAC

(Ford)

Chapter 9

BASIC ELECTRICAL TESTS, CIRCUIT PROBLEMS

Name _____

Date _____ Period _____

Instructor _____

OBJECTIVE: After studying this chapter, you will be able to describe basic electrical tests and to correct circuit problems.

INSTRUCTIONS: As you study the text, complete the workbook problems.

BASIC CIRCUIT PROBLEMS

1. A basic circuit problem is caused by something in the circuit that increases or decreases:
   a. Current.
   b. Resistance.
   c. Voltage.
   d. Any of the above.

ELECTRICAL DIAGNOSIS AND REPAIR

2. List the proper sequence for finding and fixing electrical problems. (Hint: "Veronica never touches much voltage.") _____

3. List five questions to ask yourself when trying to find the source of electrical problems.

4. True or false? The best approach to take when trying to find or correct electrical problems is the "shotgun approach."

Name _____

ELECTRICAL DIAGNOSIS AND REPAIR (Continued)

5. List the seven steps to a systematic approach to troubleshooting.

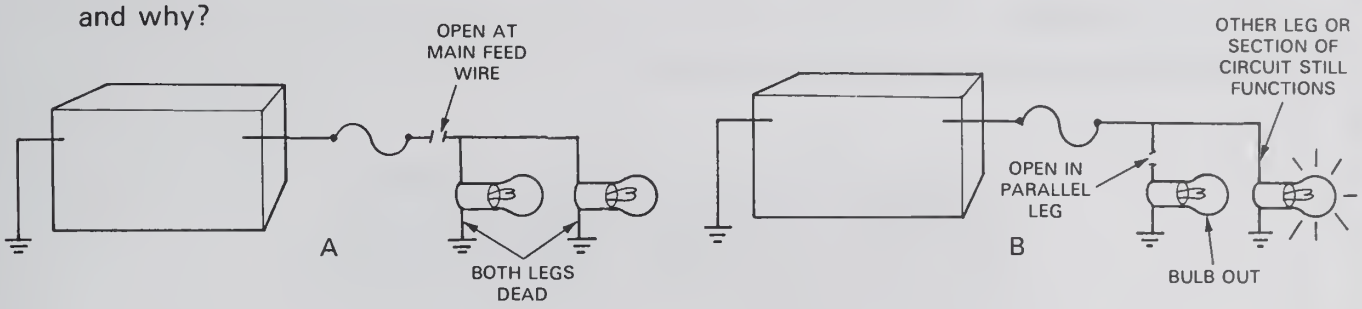
TYPES OF CIRCUIT PROBLEMS

6. Which of the following is caused by a conductor accidentally touching ground or another conductor?
   a. Open circuit.
   b. High circuit resistances.
   c. Short circuit.
   d. Intermittent problem.
7. List five ways an open circuit can be caused.
8. True or false? An intermittent problem is one that occurs all the time.

Name _____

TYPES OF CIRCUIT PROBLEMS (Continued)

9. Look at the diagrams of open parallel circuits below. In each case, where would you start testing and why?



A. _____

_____

_____

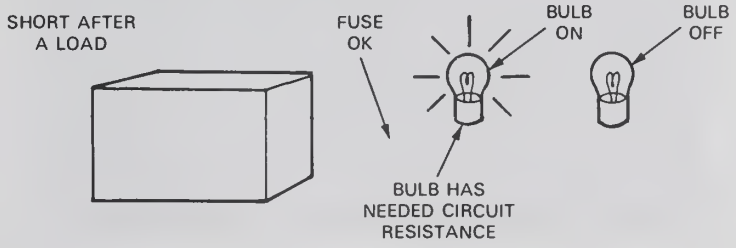
B. _____

_____

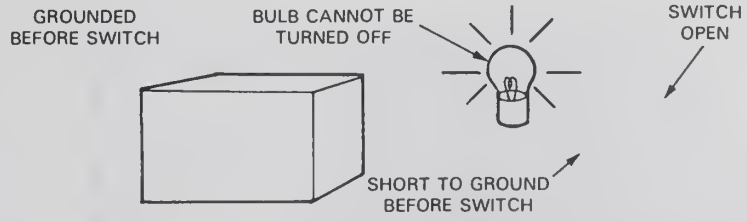
_____

10. True or false? A corroded or burned connector terminal is the most common cause of high circuit resistance.

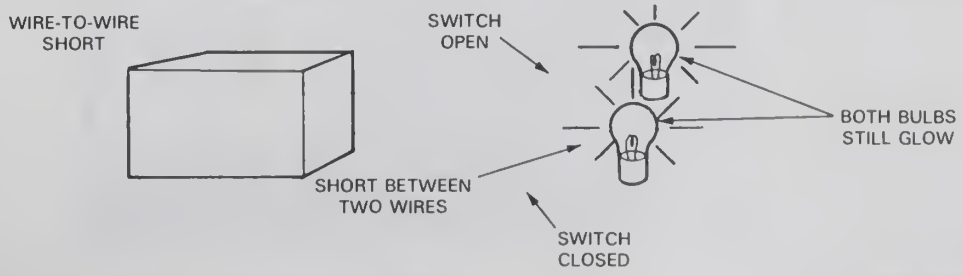
11. Look at the diagrams of short circuits below. In each case, draw the wiring described.



A—Short after a load. This short location would cut power to second bulb. However, first bulb would still work. Current blow would increase slightly because of less ohms in circuit. However, flow may not increase enough to blow fuse with resistance of one bulb still in circuit.



B—Short before a grounded switch. This would make load stay on all of the time, even with switch open. Current would bypass switch to ground.

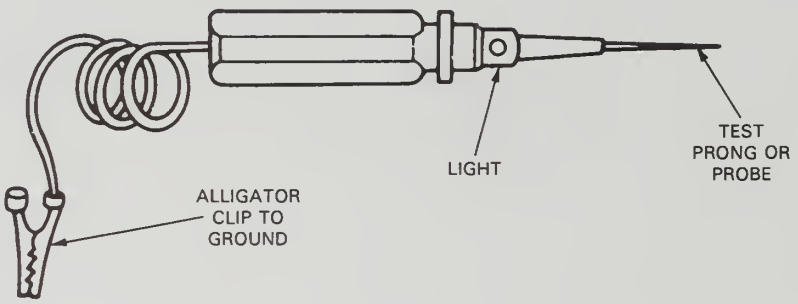


C—Wire-to-wire short. This short would feed current across two legs. Even with one switch off, current would leak over to other leg. Only with both swithes off would bulbs turn off.

Name _____

USING TESTING DEVICES

12. True or false? A jumper wire should be used to bypass a high resistance component, a fuse, or a circuit breaker.
13. Identify the item below and describe its purpose.



_____

_____

14. Explain why you should avoid using a test probe to puncture the insulation wires in a computer or sensor circuit. _____

_____

_____

_____

_____

_____

_____

15. How can a circuit breaker and compass be used to find shorts? _____

_____

_____

_____

_____

_____

_____

16. An inductive circuit tracer uses a _____ _____ and _____ _____ to find shorts.

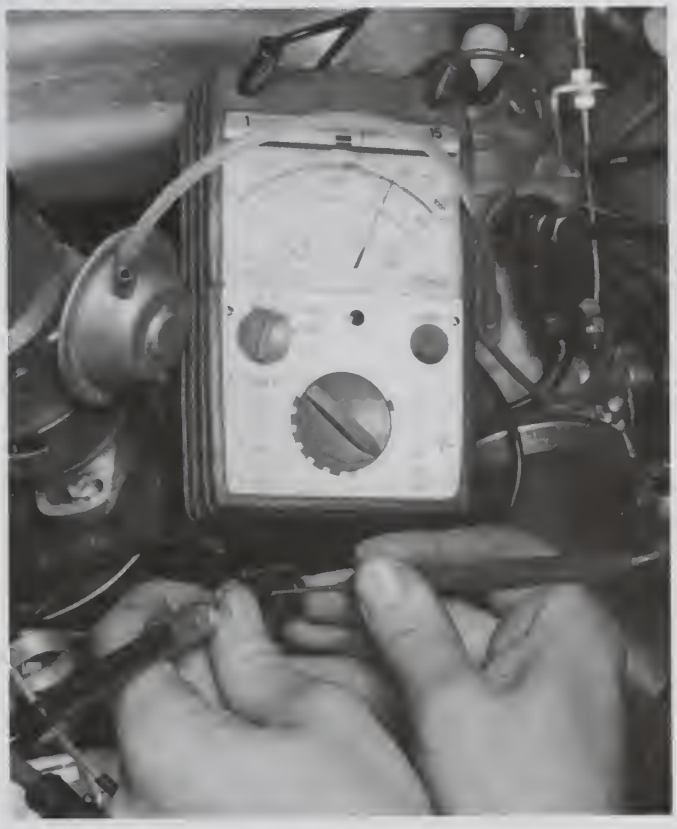
Name _____

USING MULTIMETERS

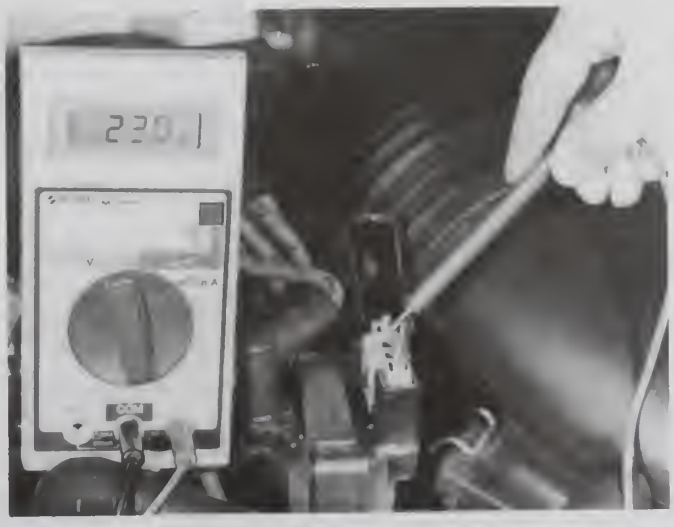
17. Identify the two basic types of multimeters below.

A. _____

B. _____



A

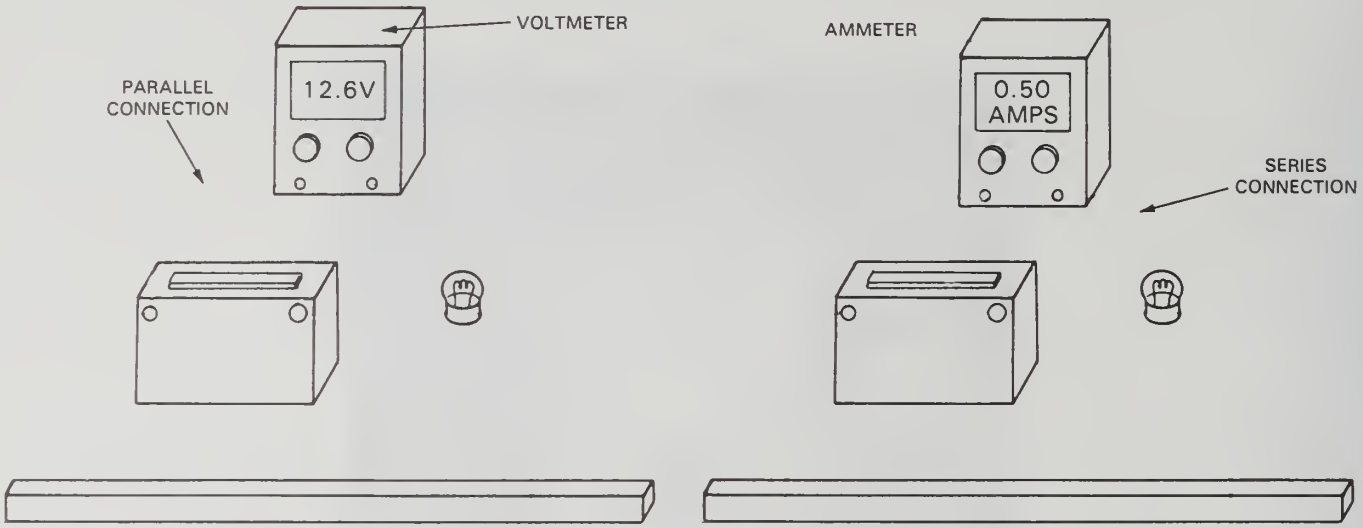


B

Name _____

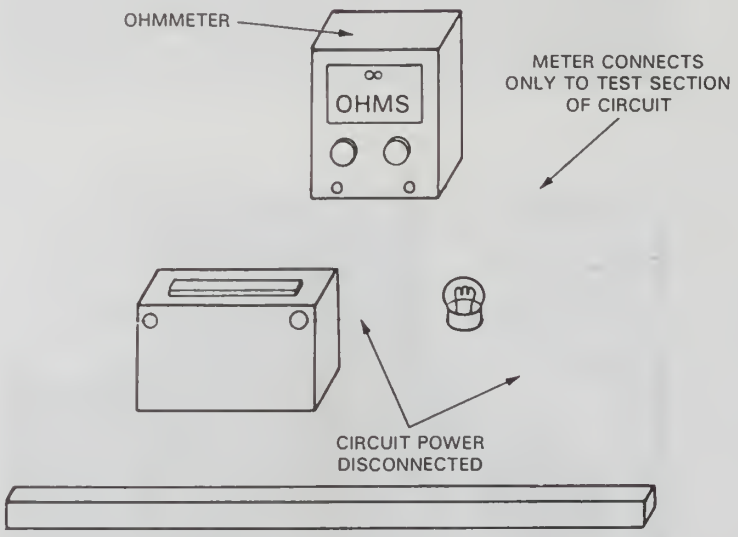
USING MULTIMETERS (Continued)

18. On the diagram below, draw in the wires showing the methods normally used to connect a voltmeter, ammeter, and ohmmeter to a circuit.



A—Voltmeter is normally connected in parallel with circuit. Then it can measure the "electrical pressure" in the circuit.

B—Conventional ammeter is wires in series with circuit. Then it can measure electron movement or current in circuit.

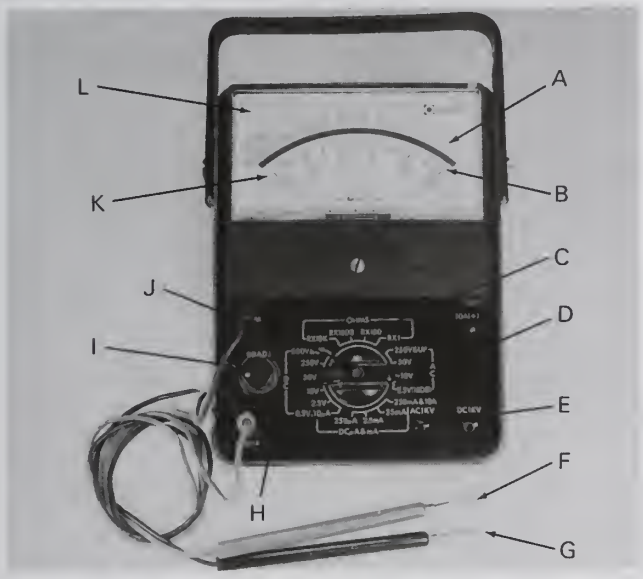


C—Ohmmeter must not be connected to circuit power. Power must be disconnected so that ohmmeter can use its battery power to measure resistance in ohms.

Name _____

USING MULTIMETERS (Continued)

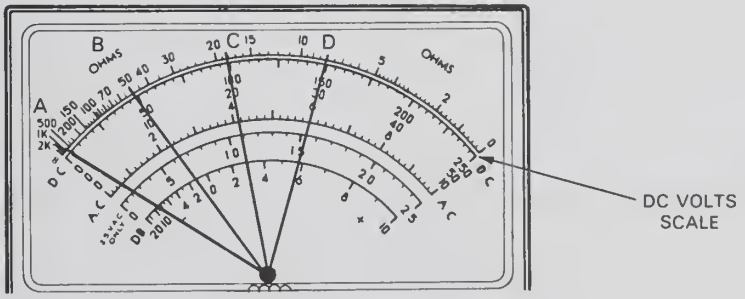
19. Identify the parts indicated on the analog multimeter below.



A. _____
B. _____
C. _____
D. _____
E. _____
F. _____
G. _____
H. _____
I. _____
J. _____
K. _____
L. _____

20. Read the analog voltmeter below, giving the voltage value at the following indicator positions below.

READING AN ANALOG VOLTMETER



RANGE SWITCH POSITION	SCALE TO READ
5 V	0-5 (50)
25 V	0-25 (250)
50 V	0-5 (50)
250 V	0-25 (250)
500 V	0-5 (50)

ANSWERS

RANGE SWITCH POSITION		VOLTAGE VALUE AT INDICATOR POSITION			
	Scale	A	B	C	D
5 V	0-5	___	___	___	___
25 V	0-25	___	___	___	___
50 V	0-5	___	___	___	___

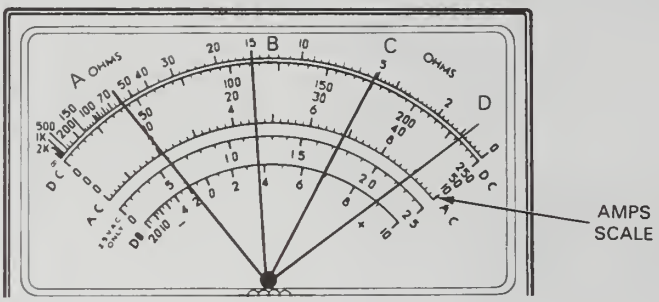
Abbreviation		Value	Symbol
1 MEGAVOLT	=	1 MILLION VOLTS (1,000,000 VOLTS)	(MV)
1 KILOVOLT	=	1 THOUSAND VOLTS (1,000 VOLTS)	(kV)
1 VOLT	=	1 VOLT	(V)
1 MILLIVOLT	=	1/1000 VOLT (.001 VOLT)	(mV)
1 MICROVOLT	=	1/1,000,000 VOLT (.000001 VOLT)	(μV)

Name _____

USING MULTIMETERS (Continued)

21. Read the analog ammeter below, giving the current value at the following indicator positions.

READING ANALOG AMMETER



1 AMPERE = 1 AMPERE
1 MILLIAMPERE = 1/1000 AMPERE OR .001 AMPERE
1 MICROAMPERE = 1/1,000,000 or .000001 AMPERE

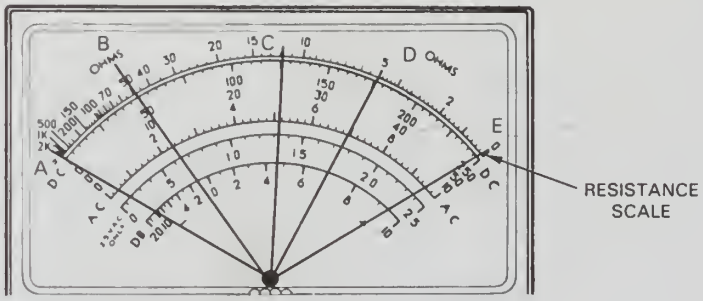
Range Switch Position	Scale Reads	Each Small Mark Equals
100 μA	0 to 100 μA	2 μA
10 mA	0 to 10 mA	.2 mA
100 mA	0 to 100 mA	2 mA
1000 mA	0 to 1000 mA	20 mA
10 A	0 to 10 A	.2 A

ANSWERS

Range Switch Position	Current Value At Indicator Position			
	A	B	C	D
100 μA	_____	_____	_____	_____
10 mA	_____	_____	_____	_____
100 mA	_____	_____	_____	_____
1000 mA	_____	_____	_____	_____
10 A	_____	_____	_____	_____

22. Read the analog ohmmeter below, giving the value in Ohms at the following indicator positions.

READING AN ANALOG OHMMETER



SCALE x 1 VALUE AS READ
SCALE x 10 MULTIPLY READING BY 10
SCALE x 1k MULTIPLY READING BY 1000
SCALE x 100k MULTIPLY READING BY 100,000

ANSWERS

Range Switch Position	Value in Ohms at Indicator Position				
	A	B	C	D	E
× 1	_____	_____	_____	_____	_____
× 10	_____	_____	_____	_____	_____
× 1k	_____	_____	_____	_____	_____
× 100k	_____	_____	_____	_____	_____

Name _____

USING MULTIMETERS (Continued)

23. A(n) _____ _____ measurement determines the internal resistance of a wire or component without disconnecting components as you would have to do with an ohmmeter.
24. True or false? Zero resistance means that there is no continuity with an infinite resistance reading.

RULES FOR USING MULTIMETERS

25. List 10 rules for using multimeters.

BASIC COMPONENT TESTS

26. A(n) _____ (bad, good) connector will have little or no resistance across its terminals. A _____ (bad, good) connector will have resistance that will lower current flow through the connector.
27. Which of the following can be used to check a connector?
    a. Test light.
    b. Voltmeter.
    c. Ohmmeter.
    d. All of the above.

Name _____

BASIC COMPONENT TESTS (Continued)

28. What is being done in the photo below? _____

_____

(Union Electronics)

29. When testing a switch, _____ should be zero when closed and infinite when open.
30. A face can quickly be checked with a(n) _____ _____.
31. A(n) _____ _____ will usually give ohms specs for different variable resistor positions. If tests show different values, the variable resistor is _____ (bad, good).
32. A(n) _____ switch will change its internal resistance with a change in a condition.
33. Why should you always ground the lead on a condenser before using it? _____

_____

_____

34. A(n) _____ is normally used to check diodes.
35. True or false? Most transistors in complex circuits require the expertise of a specialized circuit technician.
36. Describe how each of the following can be used when doing electrical tests and repairs.

Contact cleaner: _____

_____

_____

Freeze spray: _____

_____

_____

Electrical solvent: _____

_____

_____

Chapter 10

REVIEW OF SAFETY

Name _____

Date _____ Period _____

Instructor _____

OBJECTIVE: After studying this chapter, you will be able to work safely when working in an auto shop.

INSTRUCTIONS: As you study the text, complete the workbook problems.

ELECTRIC SHOCK

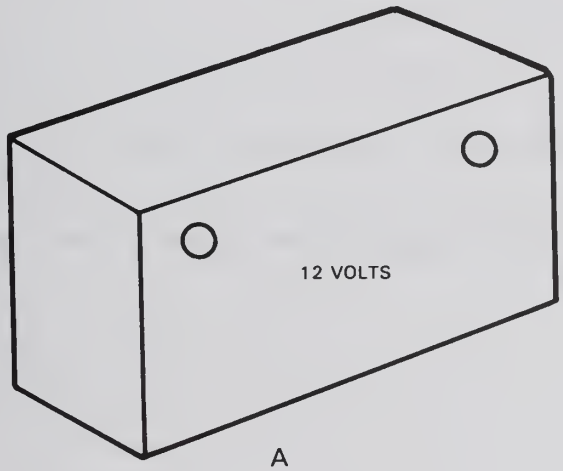
1. Identify the various sources of voltage in an auto shop.

A. _____

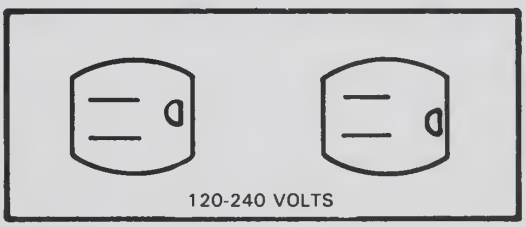
B. _____

C. _____

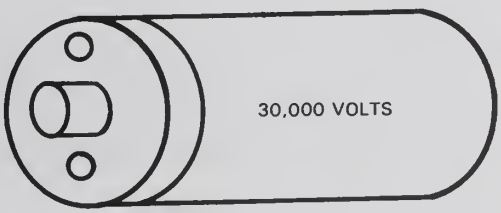
D. _____



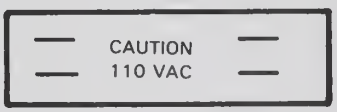
A



C



B



D

2. Some cars are equipped with a circuit that converts alternator output into 110 volts AC that can produce a current flow through your body that can cause _____.

Name _____

ELECTRIC SHOCK (Continued)

3. Explain why the ground prong should never be removed from equipment cords. _____

4. Why should you never use electrical equipment on a wet shop floor? _____

5. Why should electrical cords be kept in good condition? _____

6. What could happen if you touched the "hot" conductors in a broken light bulb? _____

7. Why should you NEVER place a drop light where it could be splashed with coolant or other liquid?

8. Why should you respect wall outlet electricity? _____

9. True or false? Some people are more susceptible to electric shock than others.
10. Discharge condensers by grounding their _____ before handling them.
11. True or false? Electrical burns are caused by the heat from electricity.
12. Which of the following is safe to wear when working on a car?
    a. A ring.
    b. A necklace.
    c. A watch.
    d. None of the above.

Name _____

ELECTRICAL FIRES

13. True or false? An electrical fire is the result of excess current heating and burning wire insulation.
14. List six steps you can take to prevent electrical fires.

BATTERY DANGERS

15. Battery _____ can happen when a flame or spark ignites hydrogen gas that can hover over the top of a battery case.
16. List four ways to prevent battery explosions.

Name _____

BATTERY DANGERS (Continued)

17. Which of the following should NOT be done when working with car batteries?
    a. Use a battery strap or carrier to remove and install car batteries.
    b. Wear eye protection.
    c. Lay tools on top of a battery.
    d. Disconnect the battery cables before charging a dead battery.

GASOLINE DANGERS

18. Which of the following statements describes a safe practice when working around gasoline?
    a. Use gasoline as a cleaning agent.
    b. Spread ''quick dry'' (oil absorbent) on gasoline spills.
    c. Keep sources of heat (soldering gun or torch) away from the engine's fuel system.
    d. Leave the car battery connected when disconnecting a fuel line on an engine.

IN CASE OF A FIRE

19. In the event of a fire in the shop, list six steps you should take.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Name _____

IN CASE OF A FIRE (Continued)

20. Look at the chart below and answer the following questions.

a. What type of extinguisher should be used on a electrical equipment fire? _____

_____

b. What type of extinguisher could be used to extinguish Class A, B, and C fires? _____

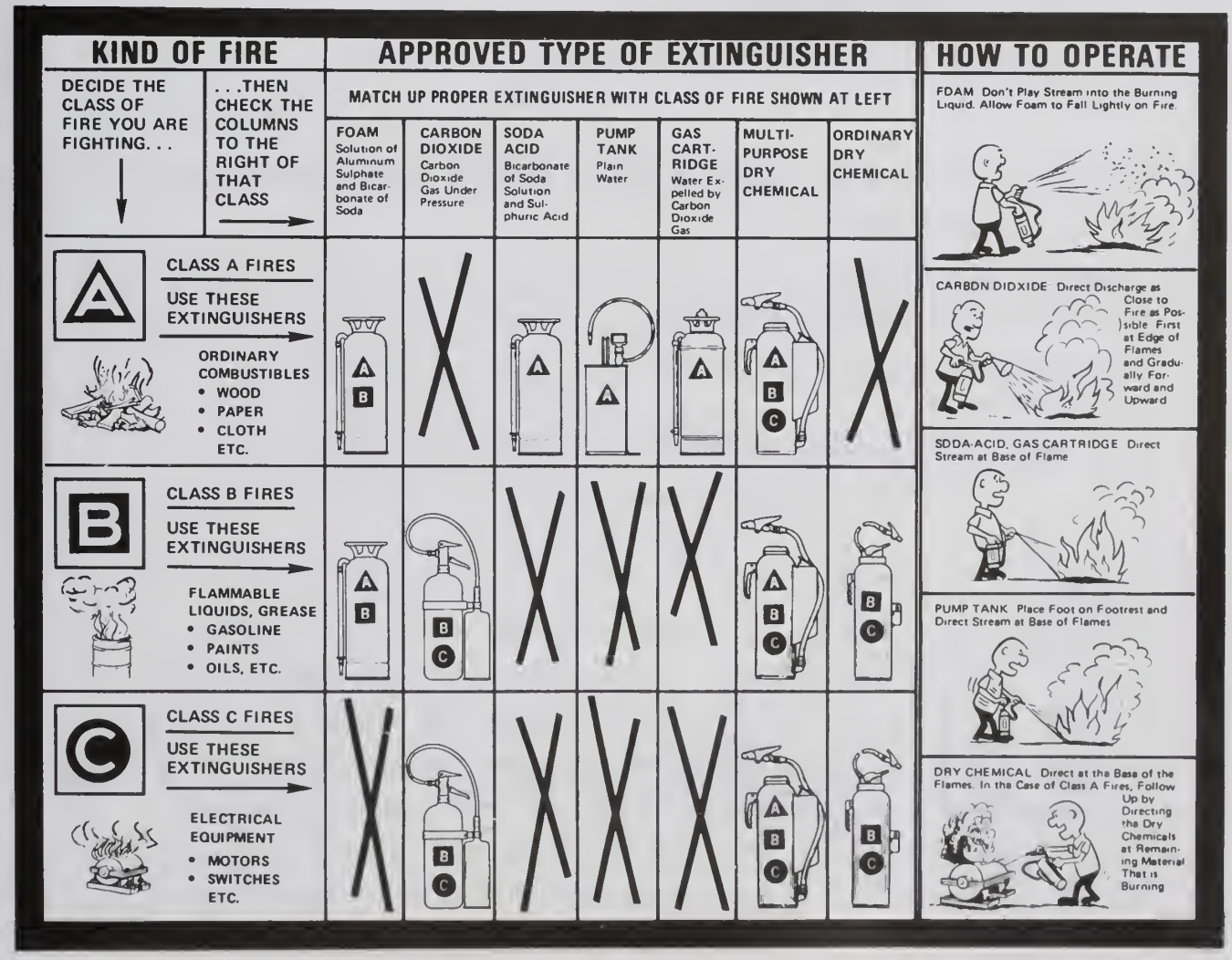
_____

c. Describe how to use a dry chemical fire extinguisher. _____

_____

_____

_____


KIND OF FIRE
DECIDE THE CLASS OF FIRE YOU ARE FIGHTING. . .
. . .THEN CHECK THE COLUMNS TO THE RIGHT OF THAT CLASS
APPROVED TYPE OF EXTINGUISHER
MATCH UP PROPER EXTINGUISHER WITH CLASS OF FIRE SHOWN AT LEFT
FOAM Solution of Aluminum Sulphate and Bicarbonate of Soda
CARBON DIOXIDE Carbon Dioxide Gas Under Pressure
SODA ACID Bicarbonate of Soda Solution and Sulphuric Acid
PUMP TANK Plain Water
GAS CARTRIDGE Water Expelled by Carbon Dioxide Gas
MULTI-PURPOSE DRY CHEMICAL
ORDINARY DRY CHEMICAL
CLASS A FIRES
USE THESE EXTINGUISHERS
ORDINARY COMBUSTIBLES
• WOOD
• PAPER
• CLOTH
ETC.
CLASS B FIRES
USE THESE EXTINGUISHERS
FLAMMABLE LIQUIDS, GREASE
• GASOLINE
• PAINTS
• OILS, ETC.
CLASS C FIRES
USE THESE EXTINGUISHERS
ELECTRICAL EQUIPMENT
• MOTORS
• SWITCHES
ETC.
HOW TO OPERATE
FOAM Don't Play Stream into the Burning Liquid. Allow Foam to Fall Lightly on Fire.
CARBON DIOXIDE Direct Discharge as Close to Fire as Possible First at Edge of Flames and Gradually Forward and Upward
SODA-ACID, GAS CARTRIDGE Direct Stream at Base of Flame
PUMP TANK Place Foot on Footrest and Direct Stream at Base of Flames
DRY CHEMICAL Direct at the Base of the Flames. In the Case of Class A Fires, Follow Up by Directing the Dry Chemicals at Remaining Material That is Burning

(Ford Motor Co.)

Name _____

OTHER SHOP DANGERS

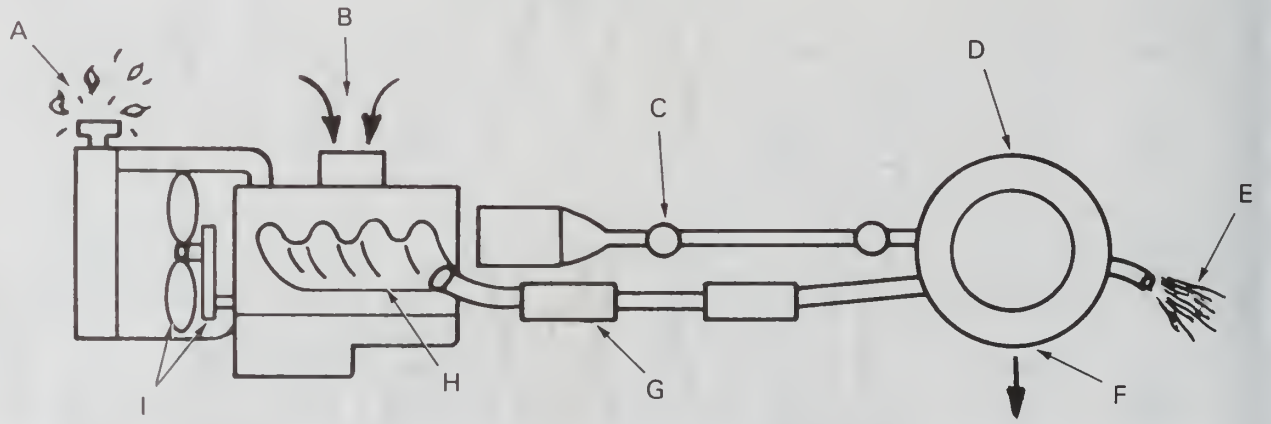
21. Identify the protection devices shown below.

A. _____
B. _____
C. _____
D. _____
E. _____
F. _____
G. _____
H. _____

BASIC SAFETY RULES

22. Wear eye protection when:
    a. Operating power tools.
    b. Working around a spinning engine fan.
    c. Carrying batteries.
    d. All of the above.
23. Identify the potential dangers on the automobile diagram shown below.

CAR'S POTENTIAL DANGERS.



A. _____
B. _____
C. _____
D. _____
E. _____
F. _____
G. _____
H. _____
I. _____

Name _____

BASIC SAFETY RULES (Continued)

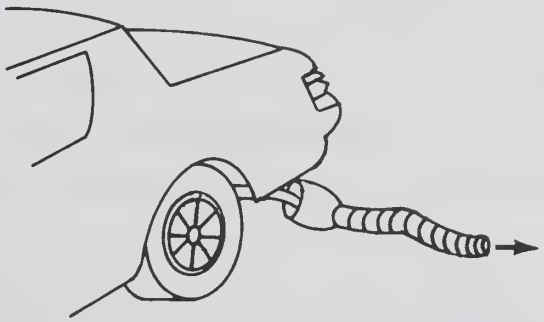
24. What has been done in the diagram below and why? _____

_____

_____

_____

_____



25. Read the following statements. If a statement describes a safe practice, place an **S** in the blank. If a statement describes an unsafe practice, place a **U** in the blank.

_____ a. Avoid anyone who does not take shop work seriously.

_____ b. Leave tools, creeper, or parts on the floor.

_____ c. Roll up long sleeves and secure long hair when working on a car.

_____ d. Never carry shop tools or parts in your pockets.

_____ e. Wear full face protection when welding.

_____ f. Use the right tool for the job.

_____ g. Remove equipment guards of shields.

_____ h. Lift with your back, not your legs.

_____ i. Use adequate lighting.

_____ j. Ventilate the work area when needed.

_____ k. Use compressed air to blow asbestos dust from parts.

_____ l. Work under a car held by a floor jack.

_____ m. Drive slowly when in the shop area.

_____ n. When a car engine is running, make sure that the transmission or transaxle is in park.

_____ o. Do not smoke.

_____ p. Avoid contact with lead.

Chapter 11

COMPUTERS, SENSORS, ACTUATORS

Name _____

Date _____ Period _____

Instructor _____

OBJECTIVE: After studying this chapter, you will be able to explain the functions of computers, sensors, and actuators.

INSTRUCTIONS: As you study the text, complete the workbook problems.

CYBERNETICS

1. The term, cybernetics, refers to the study of how electrical-mechanical mechanisms can duplicate the action of the _____ _____.
2. In comparing the human nervous system with a computer system, list the human senses or actions that would be comparable to the vehicle sensors and actuators given below.

COMPUTER SYSTEM INPUT	HUMAN NERVOUS SYSTEM
DETONATION SENSOR INPUT	_____
OXYGEN OR EXHAUST GAS SENSOR INPUT	_____
LIGHTING DIMMING PHOTO CELL INPUT	_____
PRESSURE SENSOR INPUT	_____
LOW OIL LEVEL SENSOR INPUT	_____
SOLENOID, RELAY, OR SERVO MOTOR OUTPUT	_____
DASH GRAPHIC DISPLAY OUTPUT	_____
MEMORY AND PROCESSOR IC CIRCUITS IN COMPUTER	_____

3. Match each of the following descriptions to their appropriate terms.

_____ Nervous system (input).	a. Computer.
_____ Brain (processing).	b. Sensor.
_____ Reflex action (output).	c. Actuator.

Name _____

HARDWARE AND SOFTWARE

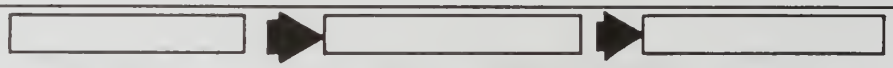
4. Briefly explain the difference between computer hardware and computer software. _____

COMPUTER ADVANTAGES

5. List nine advantages of using computers in modern automobiles.

COMPUTER ACTION

6. In the chart below, identify the three stages of computer operation by filling in the boxes.



SENSORS → MICROCOMPUTER → ACTUATORS

SENSORS (INPUT DEVICES):	MICROCOMPUTER (LOGIC DEVICES):	ACTUATORS (OUTPUT DEVICES):
• Monitor vehicle conditions	• Receives and analyzes input	• Are controlled by the microcomputer
• Relay this information (input) to the microcomputer	• Decides how vehicle operation should be adjusted	• Act on the commands issued by the microcomputer
	• Issues commands to the actuators	

(Ford)

7. Describe each of the following major sensor or input classifications.

Variable resistor type sensor: _____

Potentiometer type sensor: _____

Name _____

COMPUTER ACTION (Continued)

Switching type sensor: _____

_____

Voltage generator type sensor: _____

_____

Magnetic type sensor: _____

_____

8. Describe each of the following actuator or output classifications below.

Solenoid type output: _____

_____

Relay type output: _____

_____

Servomotor type output: _____

_____

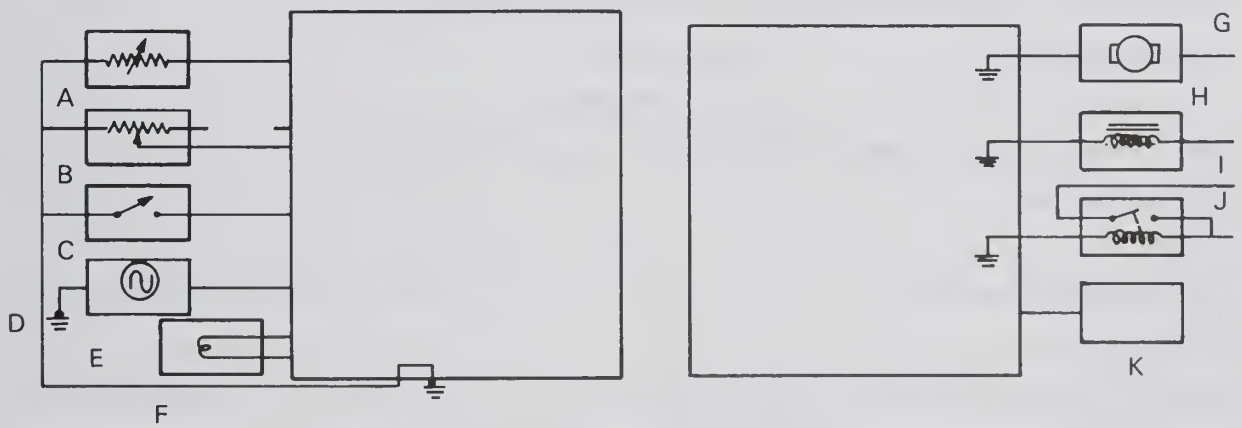
Display type output: _____

_____

Control module output: _____

_____

9. Identify the vehicle sensor categories and actuator classifications below.



A. _____ G. _____

B. _____ H. _____

C. _____ I. _____

D. _____ J. _____

E. _____ K. _____

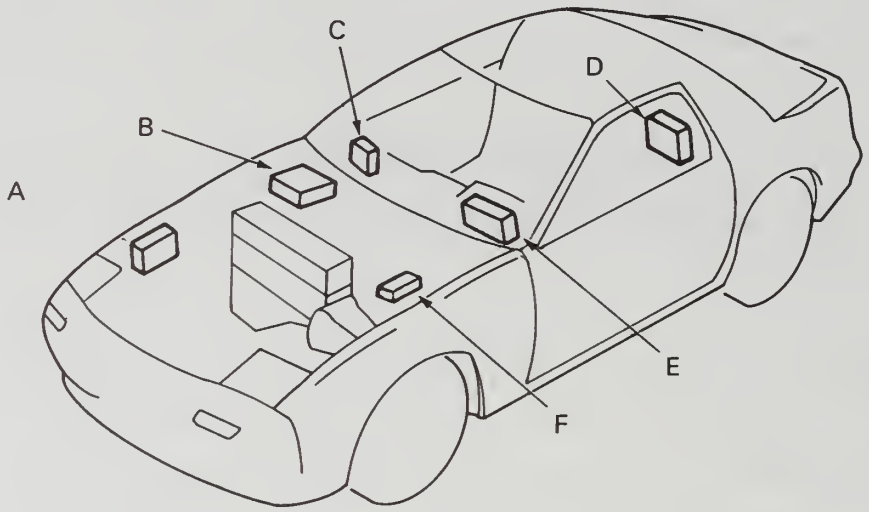
F. _____

10. A(n) _____ is a simple drawing that shows how the sensors, actuators, and computer interact.

Name _____

COMPUTER LOCATIONS, NAMES, AND TYPES

11. Name the potential locations of computers in an automobile.



A. _____ D. _____

B. _____ E. _____

C. _____ F. _____

12. The term, _____, is a general term that refers to any electronic circuit configuration that can use multiple inputs to arrive at predetermined outputs.

13. Which of the following can be another name for a computer?

a. Microprocessor. c. Logic module.

b. Electronic control unit. d. All of the above.

14. Describe the purpose of each of the following types of computers.

Main computer: _____

_____

Instrumentation computer: _____

_____

Anti-lock brake computer: _____

_____

Ignition computer: _____

_____

Engine computer: _____

_____

Suspension system computer: _____

_____

Climate control computer: _____

_____

Name _____

CONTROL MODULES

15. The control module is primarily used to _____ current for high load components such as the electric fuel pump, electric cooling fan, and air conditioning solenoid.

VEHICLE SENSOR OPERATION

16. Describe the purpose of each of the following common vehicle sensors.

Air temperature sensor: _____

Engine temperature sensor: _____

Oxygen sensor: _____

Manifold pressure sensor: _____

Barometric pressure sensor: _____

Throttle position sensor: _____

Engine speed sensor: _____

Crank position sensor: _____

Airflow sensor: _____

Knock sensor: _____

Transaxle/transmission sensor: _____

Brake sensor: _____

Camshaft sensor: _____

Oil level sensor: _____

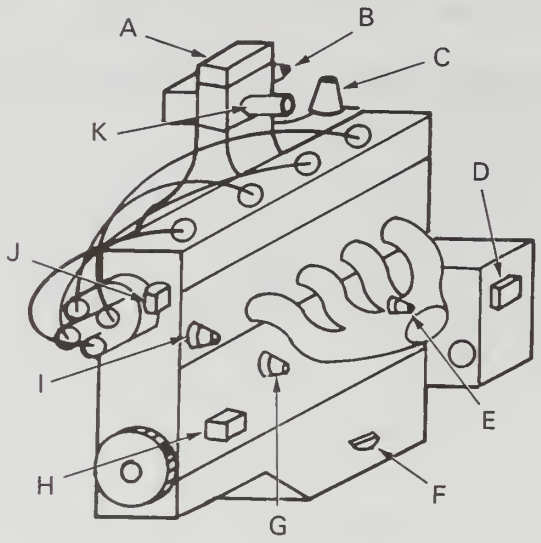
EGR sensor: _____

Impact sensor: _____

Name _____

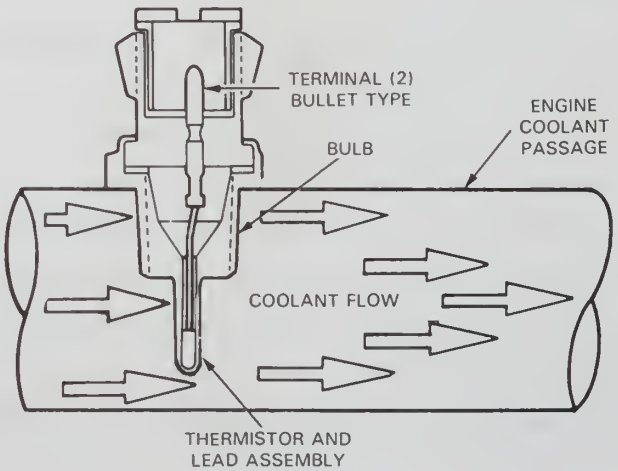
VEHICLE SENSOR OPERATION (Continued)

17. Identify the sensors on the diagram below.



A. _____
B. _____
C. _____
D. _____
E. _____
F. _____
G. _____
H. _____
I. _____
J. _____
K. _____

18. A(n) _____ (active, passive) sensor is one that generates its own voltage signal. A(n) _____ (active, passive) sensor depends on an external source of voltage to return a signal to the computer.
19. The reference voltage, abbreviated Vref, is typically around _____ volts.
20. True or false? Some computer systems use more than one oxygen sensor to monitor combustion efficiency.
21. The oxygen sensor _____ _____ is used to determine a standard for the most ideal air-fuel ratio.
22. After the engine warms to operating temperature, the system changes to a(n) _____ (closed, open) loop operating mode, using feedback from sensors to control the system.
23. True or false? The inlet air temperature sensor helps the computer compensate for changes in outside air temperature and maintains an almost perfect air-fuel ratio.
24. What type of sensor is shown in the diagram below? _____



(Ford)

Name _____

VEHICLE SENSOR OPERATION (Continued)

25. The throttle position sensor provides data input on the _____ output of the engine.
26. As engine speed and airflow _____ (decrease, increase), air forces the flap on the flap airflow sensor to swing open.
27. A mass airflow sensor is desirable because it will automatically compensate for:
    a. Air temperature.
    b. Atmospheric pressure.
    c. Humidity.
    d. All of the above.
28. True or false? The crankshaft sensor monitors the rotation of the engine camshaft.
29. List the three basic types of MAP sensors.

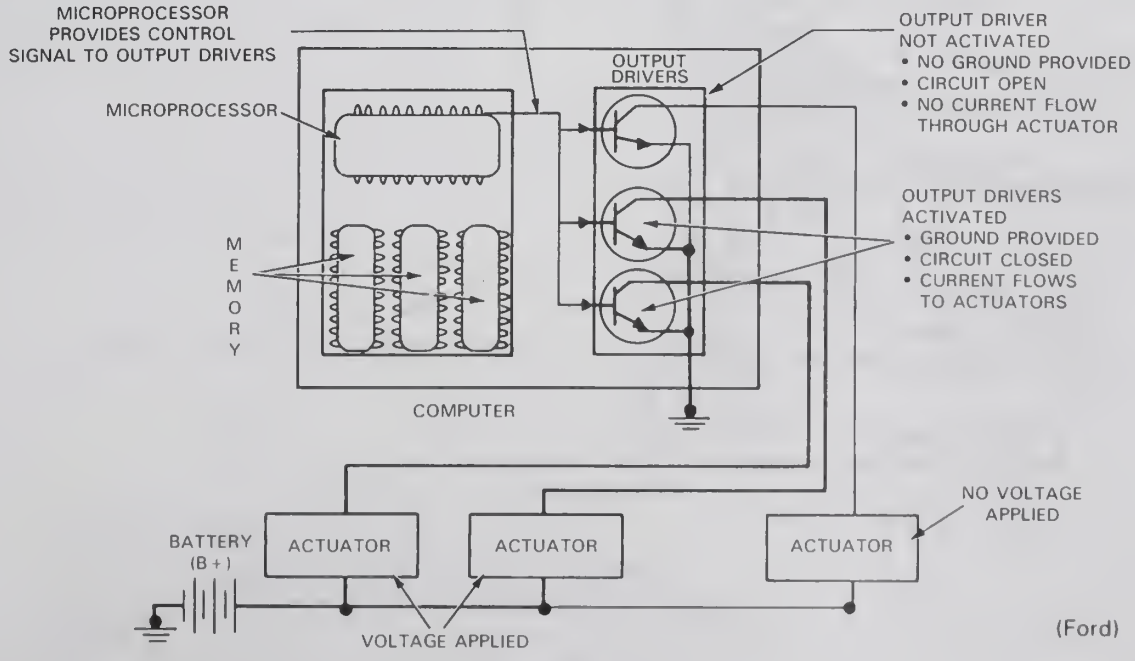
    _____

    _____

    _____
30. True or false? When the knock sensor detects knock, an electrical signal allows the computer to retard the ignition timing or lower turbocharge boost enough to prevent engine damage.
31. The _____ _____ _____ allows the computer to activate a dash warning light or even "kill" the engine when oil is below a specific point.
32. The vehicle speed sensor produces a _____ (high, low) frequency signal when the car is moving slowly and a _____ (higher, lower) frequency signal with more speed.

ACTUATOR OPERATION

33. On the diagram below, use arrows to indicate the circuit path from the actuators to the computer.



(Ford)

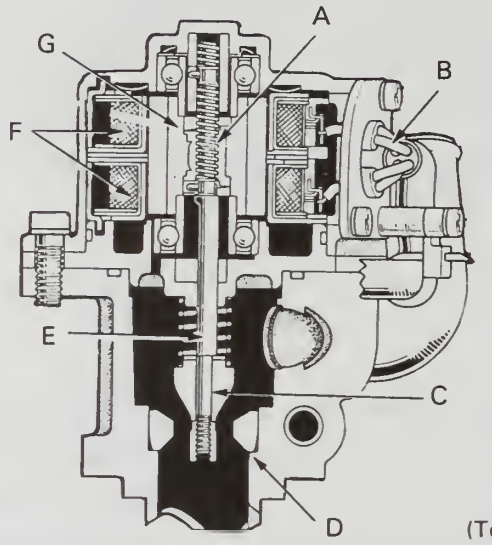
Name _____

ACTUATOR OPERATION (Continued)

34. True or false? A solenoid actuator can be used to operate a vacuum switch.

35. A(n) _____ can serve as a good actuator when a high current load must be controlled by the computer.

36. Identify the parts indicated on this motor type actuator.

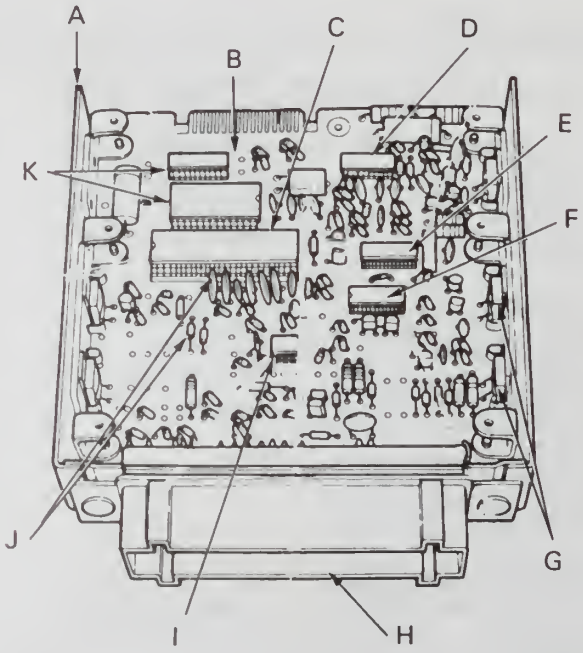


(Toyota)

A. _____
B. _____
C. _____
D. _____
E. _____
F. _____
G. _____

COMPUTER OPERATION

37. Identify the basic parts indicated on the diagram of the computer below.



(Ford)

A. _____
B. _____
C. _____
D. _____
E. _____
F. _____
G. _____
H. _____
I. _____
J. _____
K. _____

Name _____

COMPUTER OPERATION (Continued)

38. Describe the purpose of each of the following parts of a computer listed below.

Voltage regulator: _____

_____

Amplifiers: _____

_____

Conditioners: _____

_____

Microprocessor: _____

_____

Memory: _____

_____

Clock: _____

_____

Output drivers: _____

_____

Circuit boards: _____

_____

Harness connector: _____

_____

Computer housing: _____

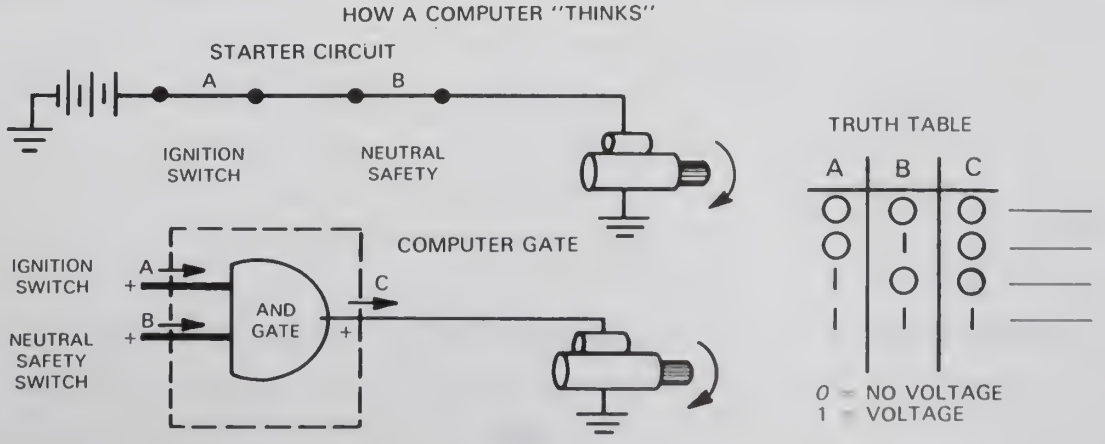
_____

39. True or false? A computer amplifier simply weakens various signals when inside the computer.
40. True or false? An input conditioner is needed to change digital signals into analog signals.
41. List two purposes of a buffer.

_____

_____

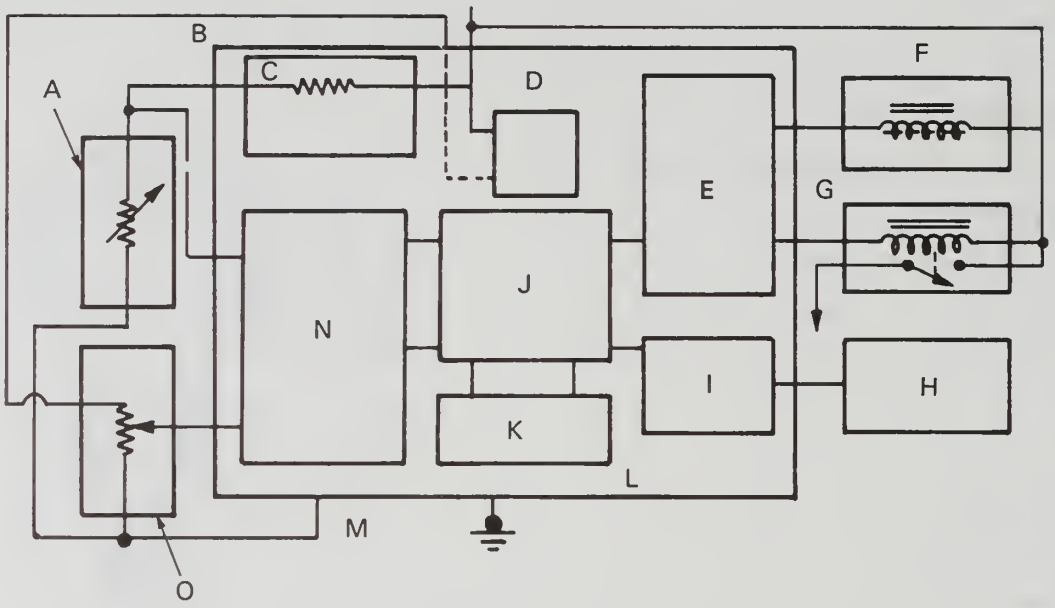
42. Study the diagram below. Then complete the truth table under Column C, indicating whether or not the motor is on or off.



Name _____

COMPUTER OPERATION (Continued)

43. Identify the items indicated on the block diagram of the computer system below.



A. _____ I. _____
B. _____ J. _____
C. _____ K. _____
D. _____ L. _____
E. _____ M. _____
F. _____ N. _____
G. _____ O. _____
H. _____

44. A memory rating is an indication of a chip's ability to _____ _____.
45. True or false? Read-write memory stores data permanently in its circuitry.
46. The abbreviations for the four basic types of computer memory are listed below. Name them and describe their functions.

RAM: _____

_____

_____

_____

ROM: _____

_____

_____

_____

Name _____

COMPUTER OPERATION (Continued)

PROM: _____

_____

_____

_____

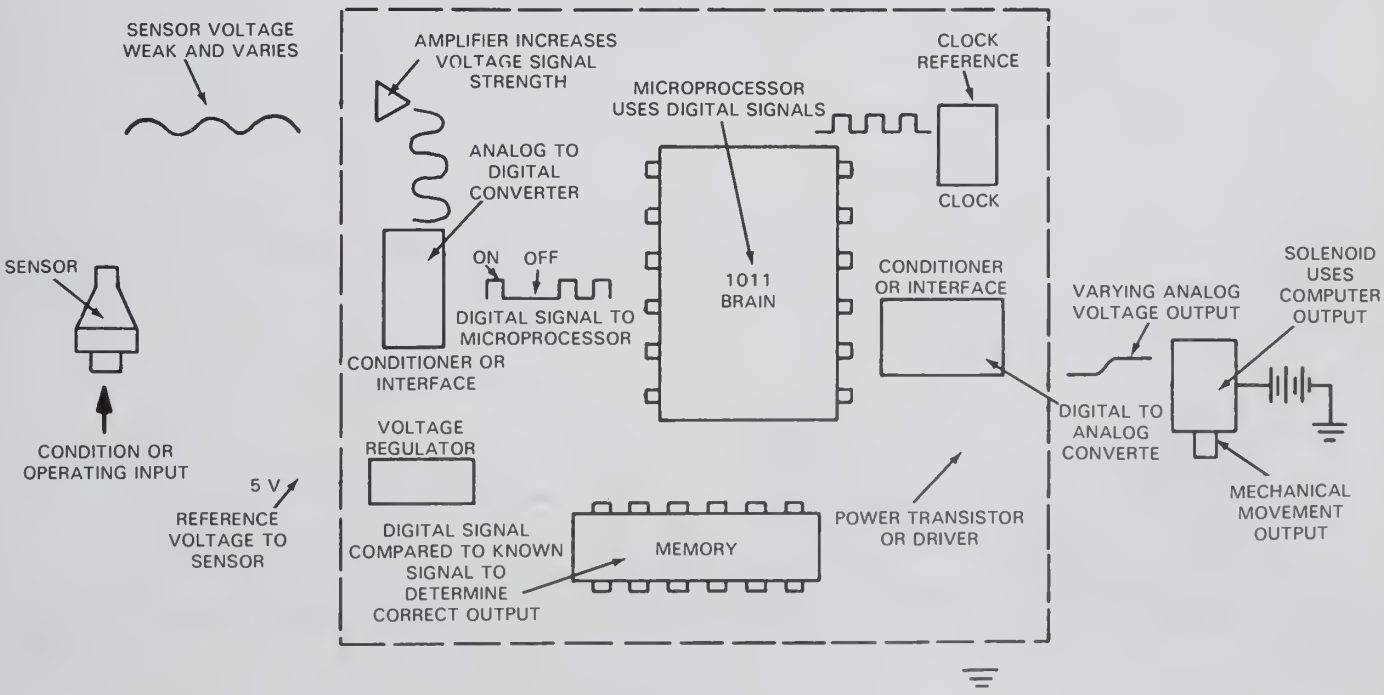
KAM: _____

_____

_____

_____

47. The term _____-_____ _____ refers to how these two sections of a computer communicate or exchange data.
48. A memory address will store data as _____ numbers at specific pins or locations in the memory chips of a computer.
49. A microprocessor will compare an input binary number with a known correct binary number in _____. The microprocessor can then determine what _____ is needed.
50. Using arrows or a colored pencil, trace the flow of data through this simplified computer system.



51. A computer can be classified by the amount of _____ it can process.

Chapter 12

BATTERIES

Name _____

Date _____ Period _____

Instructor _____

OBJECTIVE: After studying this chapter, you will be able to describe the operation, functions, and construction of batteries.

INSTRUCTIONS: As you study the text, complete the workbook problems.

BATTERY OPERATION

1. A battery is:
   a. A chemical device.
   b. An electrical device.
   c. A chemical-electrical device.
   d. None of the above.
2. Battery _____ refers to when current is flowing out of the battery.
3. Battery _____ refers to when current is flowing back into the battery.
4. List and describe the four basic parts of a battery cell.

_____

_____

_____

_____

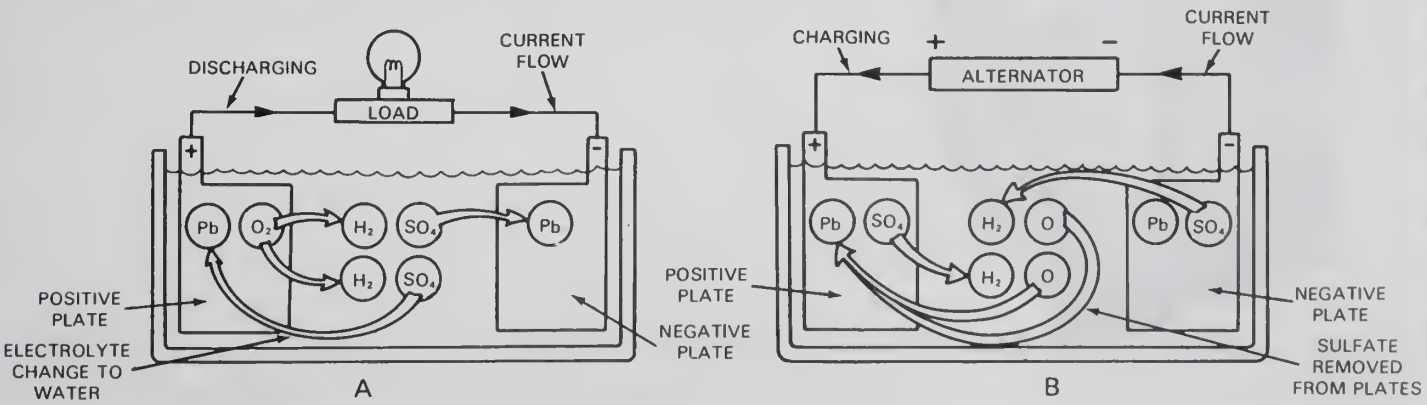
_____

_____

_____

_____

5. Look at the diagram below. Describe what is happening in each one.



A. _____

_____

B. _____

_____

Name _____

BATTERY FUNCTIONS

6. List five important functions of an auto battery.

_____

_____

_____

_____

_____

BATTERY CONSTRUCTION

7. A battery element is made up of:
   a. Positive plates.
   b. Negative plates.
   c. Straps and separators.
   d. All of the above.
8. Battery _____ are made of a grid coated with porous lead.
9. Identify the parts indicated on the battery below.

(Gould)

A. _____
B. _____
C. _____
D. _____
E. _____
F. _____
G. _____
H. _____
I. _____

Name _____

BATTERY CONSTRUCTION (Continued)

10. Explain why electrolyte must never come in contact with your skin or eyes.

_____

_____

_____

11. Battery _____ provide a means of connecting the battery plates to the car's electrical system.

BATTERY CABLES

12. The _____ (negative, positive) battery cable is normally red and fastens to the starter solenoid. The _____ (negative, positive) battery cable is usually black and connects to the ground on the engine block.
13. A battery cable _____ _____ allows other wires to make electrical contact with the positive battery cable.
14. True or false? When two batteries are connected in series, their output voltage doubles.

WET- AND DRY-CHARGED BATTERIES

15. True or false? A wet-charged battery contains fully charges elements, but does not contain electrolyte.

MAINTENANCE-FREE BATTERY

16. True or false? A maintenance-free battery is easily identified because it uses removable filler caps.
17. In maintenance-free batteries, since _____ is used to make the battery plates, gassing and loss of electrolyte is reduced.

BATTERY RATINGS

18. Name and describe two types of battery ratings.

_____

_____

_____

_____

_____

_____

19. A(n) _____ rating is the equivalent of the cold cranking rating and measures how well the battery can crank an engine when at 0 °F (−18 °C).

BATTERY TEMPERATURE AND EFFICIENCY

20. As battery temperature drops, battery power is _____ (decreased, increased).

Chapter 13

STARTING SYSTEMS

Name _____

Date _____ Period _____

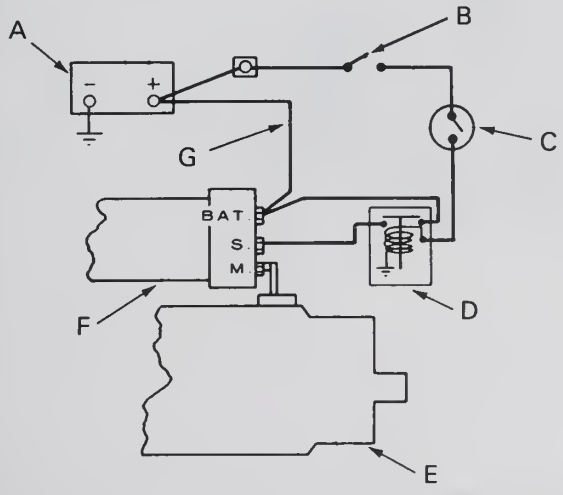
Instructor _____

OBJECTIVE: After studying this chapter, you will be able to identify parts of starting systems and describe how they operate.

INSTRUCTIONS: As you study the text, complete the workbook problems.

MAJOR STARTING SYSTEM PARTS

1. Identify the parts indicated on the starting circuit below.



(General Motors)

A. _____

B. _____

C. _____

D. _____

E. _____

F. _____

G. _____

2. The major parts of a starting system are listed below. Describe their purposes.

Battery: _____

_____

Ignition switch: _____

_____

Neutral safety switch: _____

_____

Starter solenoid: _____

_____

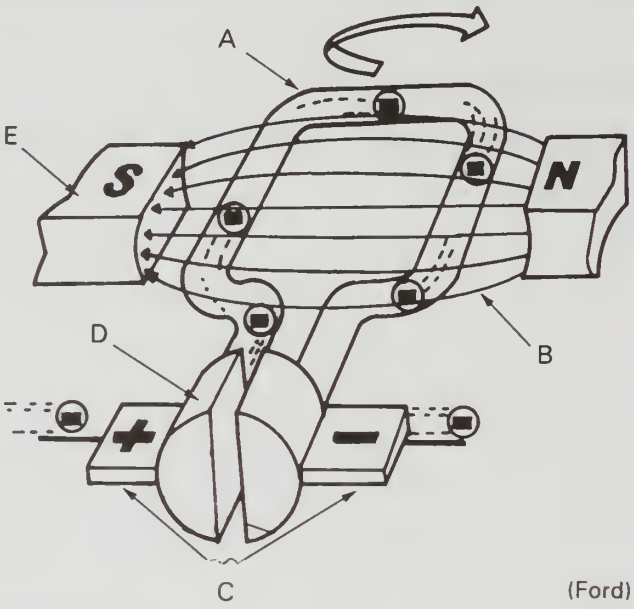
Cranking motor: _____

_____

Name _____

STARTING MOTOR OPERATION

3. The starting motor, also called the cranking motor, changes the _____ (electrical, mechanical) energy from the battery into _____ (electrical, mechanical) energy to spin the engine crankshaft.
4. Identify the items indicated on the illustration below.



(Ford)

A. _____
B. _____
C. _____
D. _____
E. _____

5. The _____ serves as a sliding electrical connection between the motor windings and the brushes.
6. The _____ slide on the commutator to carry battery current to the spinning windings.
7. The _____ _____ is a metal framework with several sets of windings (loops) wrapped around it.
8. The _____ _____ _____ is the stationary magnetic flux around the armature.
9. The _____ _____ in a starting motor are insulated wires wrapped around iron cores.
10. True or false? Some new starting motors use only permanent magnets to produce a stationary field.

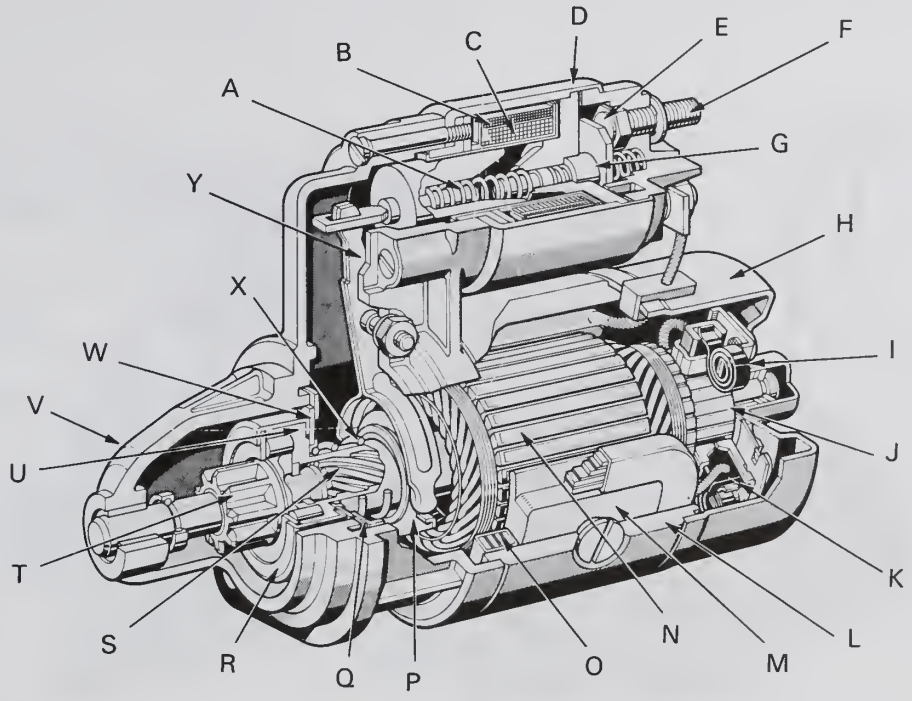
STARTER FRAMES

11. The _____ _____ or field frame is the large steel cylinder that holds the field coils and/or field magnets.
12. The _____ _____ _____ is the housing around the starting motor drive gear.

Name _____

STARTER FRAMES (Continued)

13. Identify the parts indicated on the diagram of the starting motor below.



(Robert Bosch)

A. _____
B. _____
C. _____
D. _____
E. _____
F. _____
G. _____
H. _____
I. _____
J. _____
K. _____
L. _____
M. _____
N. _____
O. _____
P. _____
Q. _____
R. _____
S. _____
T. _____
U. _____
V. _____
W. _____
X. _____
Y. _____

14. The _____ _____ _____ usually holds the brushes and springs around the armature commutator.
15. The _____ _____ _____ locks the pinion gear in one direction and releases it in the other.
16. A(n) _____ _____ _____ is the small gear on the overrunning clutch.

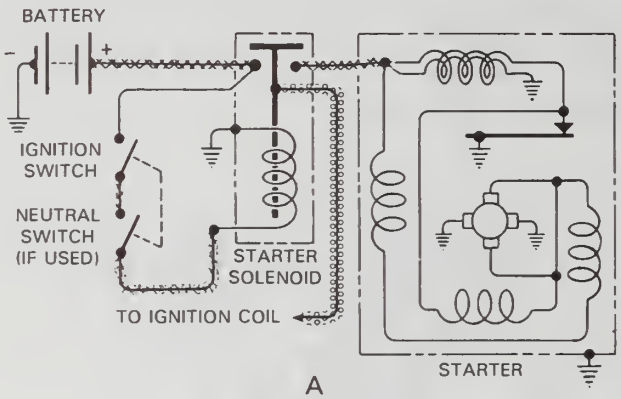
Name _____

STARTING MOTOR CLASSIFICATIONS

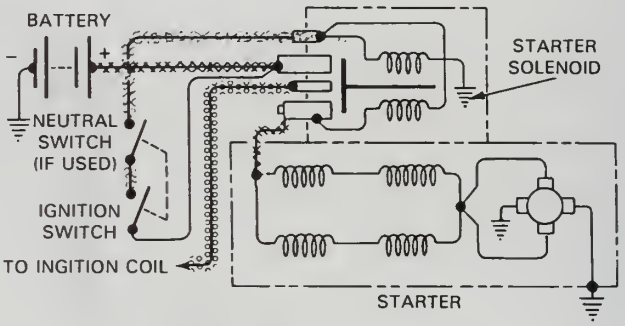
17. Identify the two types of starting motors diagramed below.

A. _____

B. _____



A



B

CONTROL CIRCUIT MOTOR FEED CIRCUIT IGNITION BYPASS

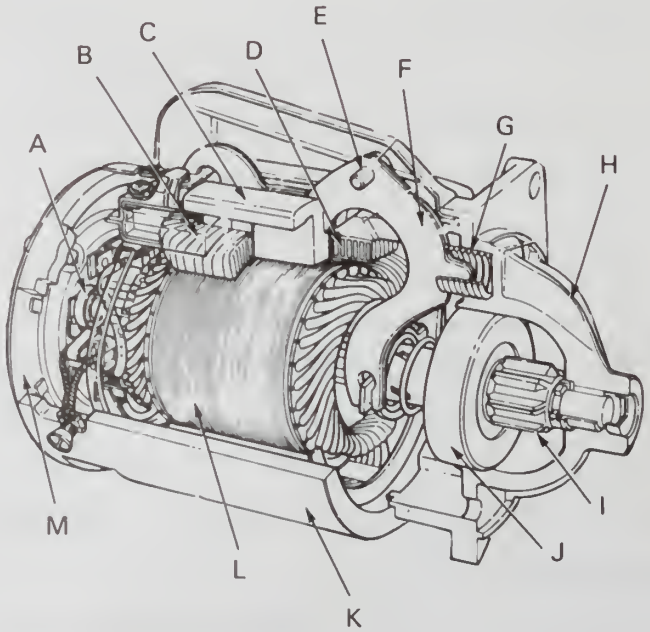
18. List the three types of internal connections in direct current electric motors. _____

_____

_____

_____

19. Identify the parts indicated on the positive engagement starting motor below.



A. _____

B. _____

C. _____

D. _____

E. _____

F. _____

G. _____

H. _____

I. _____

J. _____

K. _____

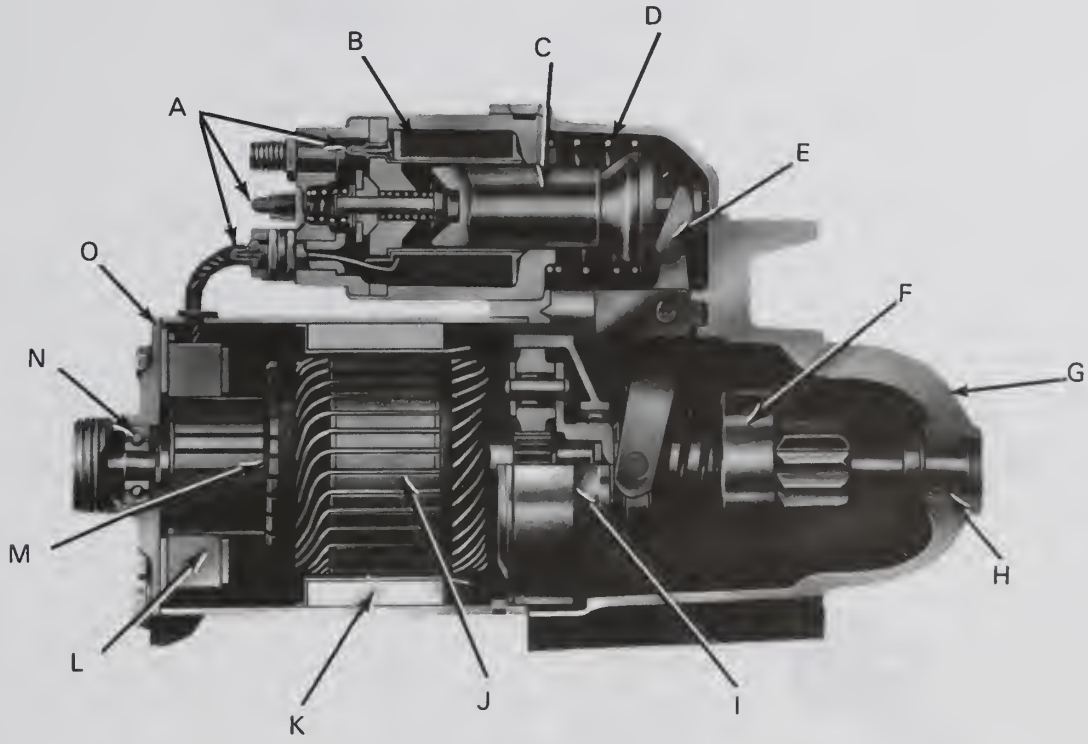
L. _____

M. _____

Name _____

STARTER MOTOR CLASSIFICATIONS (Continued)

20. Identify the parts indicated on the solenoid-actuated starting motor below.

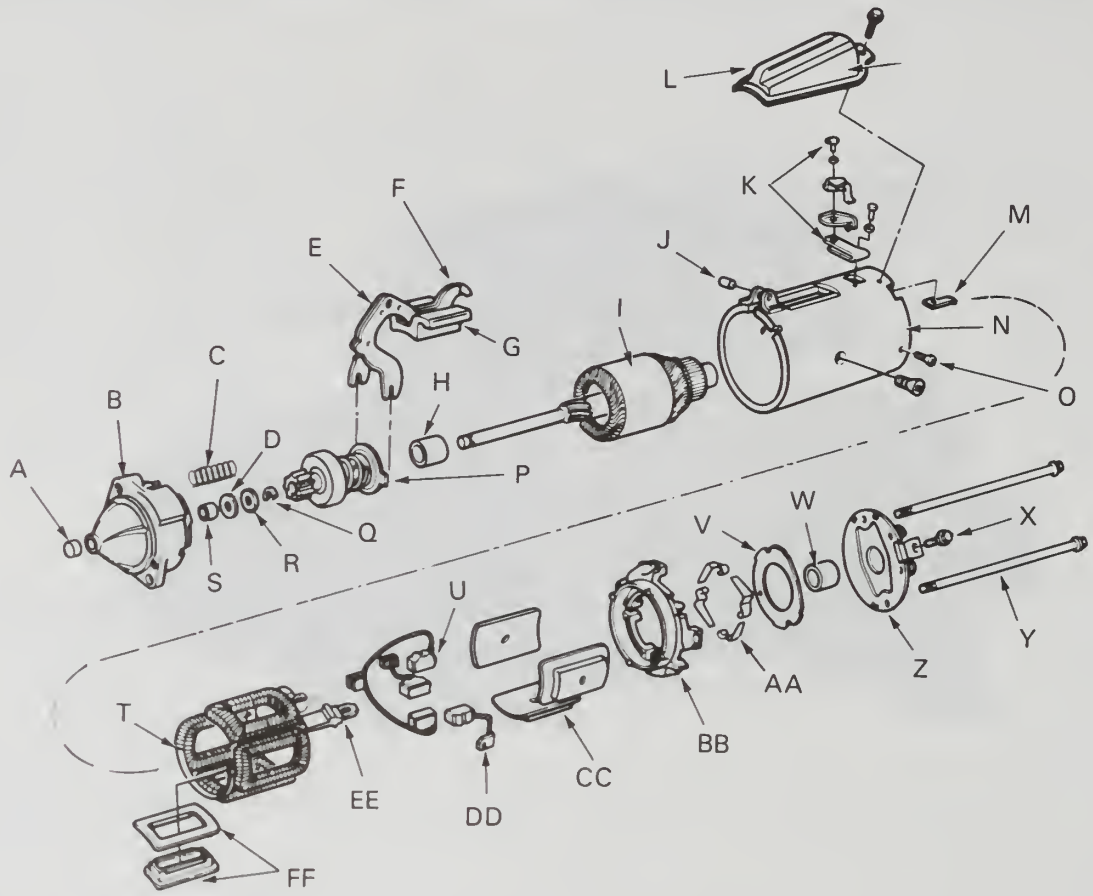


A. _____
B. _____
C. _____
D. _____
E. _____
F. _____
G. _____
H. _____
I. _____
J. _____
K. _____
L. _____
M. _____
N. _____
O. _____

Name _____

STARTER MOTOR CLASSIFICATIONS (Continued)

21. Identify the parts indicated on the exploded view of the positive engagement starter shown below.



(Ford)

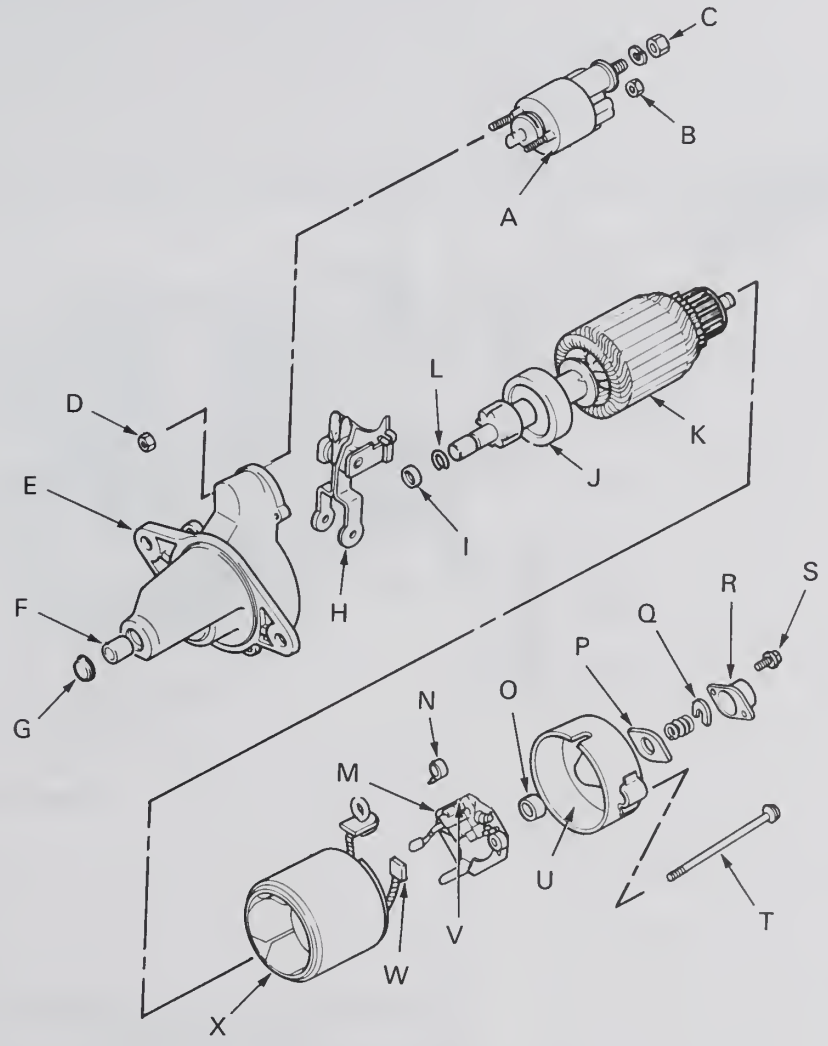
A. _____
B. _____
C. _____
D. _____
E. _____
F. _____
G. _____
H. _____
I. _____
J. _____
K. _____
L. _____
M. _____
N. _____
O. _____
P. _____

Q. _____
R. _____
S. _____
T. _____
U. _____
V. _____
W. _____
X. _____
Y. _____
Z. _____
AA. _____
BB. _____
CC. _____
DD. _____
EE. _____
FF. _____

Name _____

STARTER MOTOR CLASSIFICATIONS (Continued)

22. Identify the parts indicated on the exploded view of the solenoid-engaged starter below.



(Oldsmobile)

A. _____ M. _____

B. _____ N. _____

C. _____ O. _____

D. _____ P. _____

E. _____ Q. _____

F. _____ R. _____

G. _____ S. _____

H. _____ T. _____

I. _____ U. _____

J. _____ V. _____

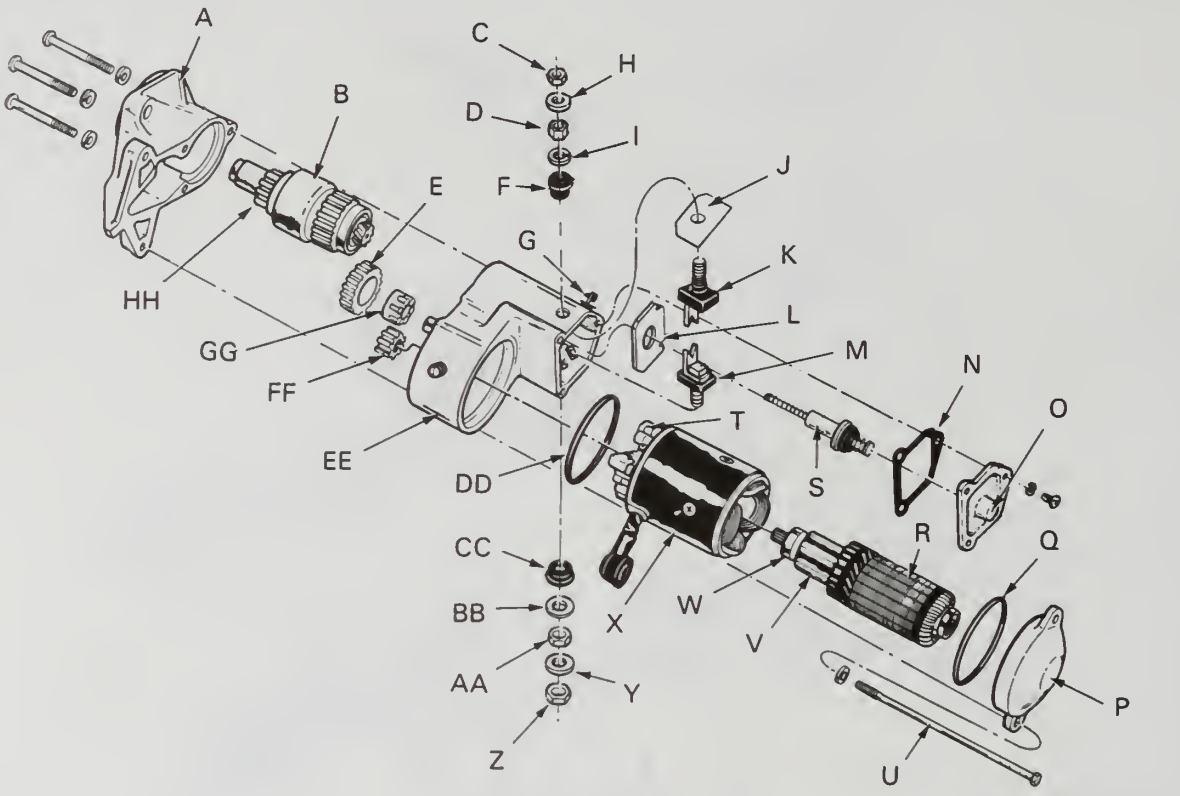
K. _____ W. _____

L. _____ X. _____

Name _____

STARTING MOTOR CLASSIFICATIONS (Continued)

23. Identify the parts indicated on the exploded view of a gear reduction starting motor below.



(General Motors)

A. _____
B. _____
C. _____
D. _____
E. _____
F. _____
G. _____
H. _____
I. _____
J. _____
K. _____
L. _____
M. _____
N. _____
O. _____
P. _____
Q. _____
R. _____
S. _____
T. _____
U. _____
V. _____
W. _____
X. _____
Y. _____
Z. _____
AA. _____
BB. _____
CC. _____
DD. _____
EE. _____
FF. _____
GG. _____
HH. _____

Name _____

STARTING SOLENOIDS

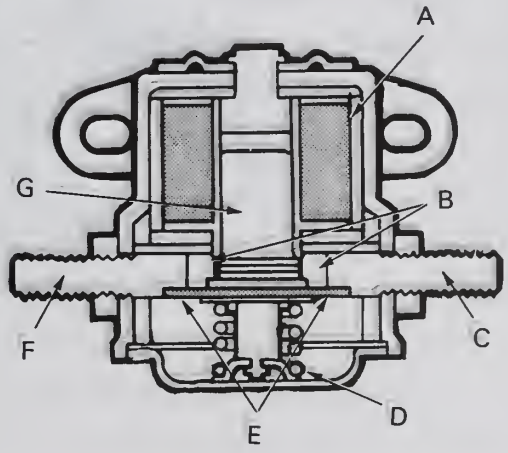
24. List three functions of a starter solenoid.

_____

_____

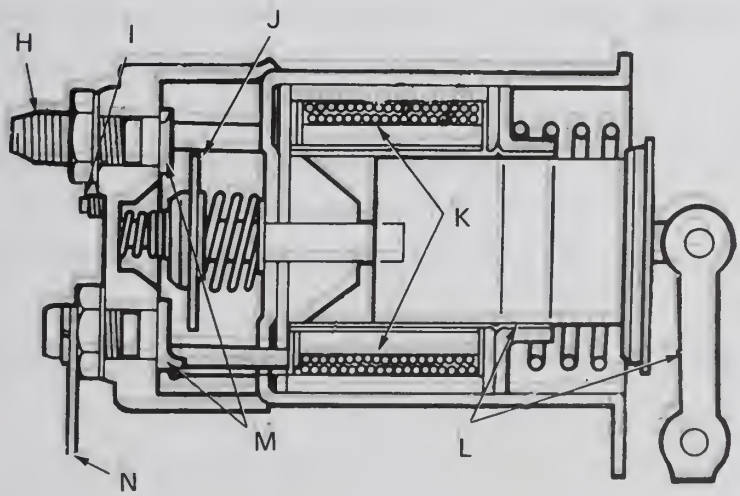
_____

25. Name the two types of solenoids below and identify the parts indicated on them.



_____

A. _____
B. _____
C. _____
D. _____
E. _____
F. _____
G. _____
H. _____
I. _____
J. _____
K. _____
L. _____
M. _____
N. _____



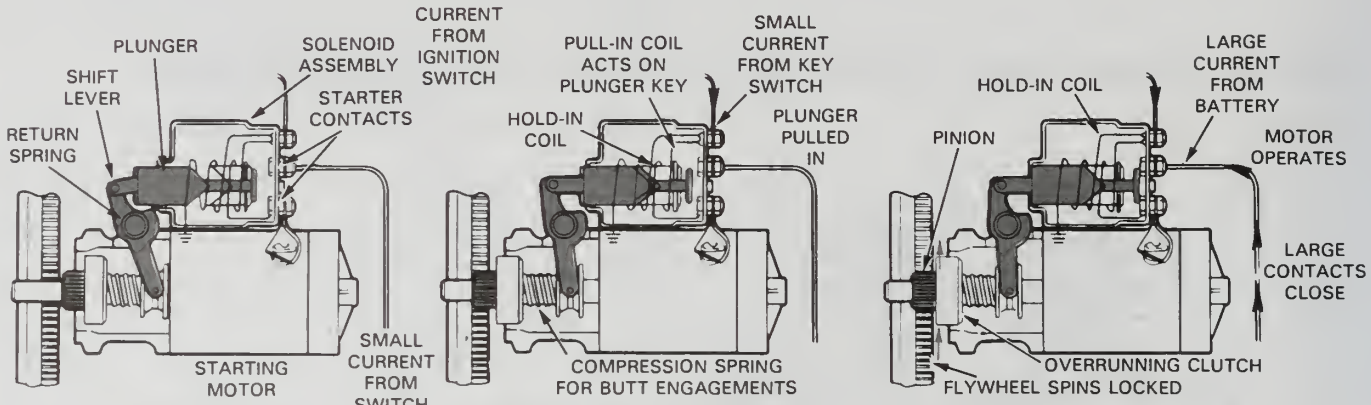
_____

(Chrysler)

Name _____

STARTING SOLENOIDS (Continued)

26. Describe what is happening in the diagrams below.



(Chrysler)

A. _____

_____

B. _____

_____

C. _____

_____

STARTER RELAY

27. A starter relay uses a _____ (large, small) current flow from the ignition switch to control a slightly larger current flow to the starter solenoid.
28. A(n) _____ safety switch prevents the engine from cranking unless the shift lever is in neutral or park.
29. A(n) _____ safety switch can be used with cars using manual transmissions or transaxles to prevent engine cranking.
30. True or false? A neutral safety switch and the clutch safety switch are usually wired in series with the starter solenoid or relay.

Chapter 14

CHARGING SYSTEMS

Name _____

Date _____ Period _____

Instructor _____

OBJECTIVE: After studying this chapter, you will be able to describe how charging systems operate.

INSTRUCTIONS: As you study the text, complete the workbook problems.

BASIC CHARGING CIRCUIT

1. List and describe the seven fundamental components of a charging system.

PURPOSE OF THE CHARGING SYSTEM

2. Name the four functions of the charging system.

Name _____

ALTERNATOR OPERATION

3. What is the alternator designed to do? _____

_____

_____

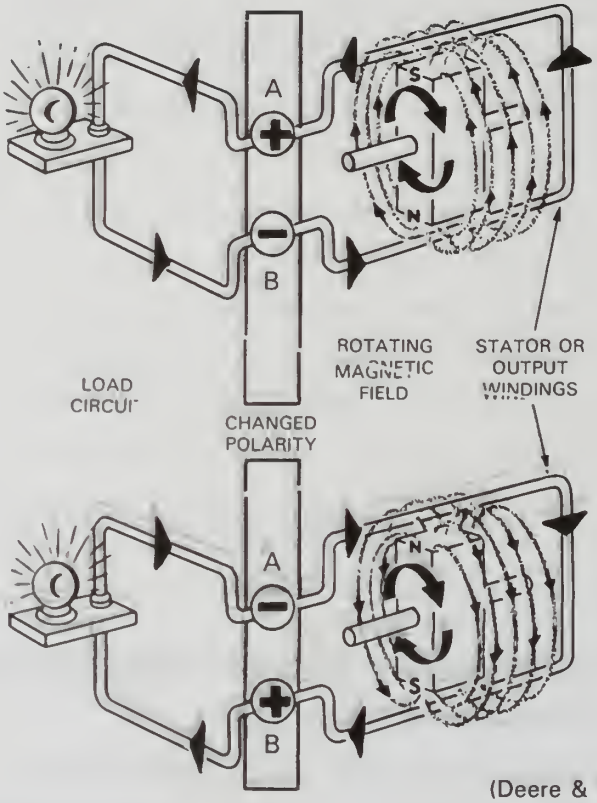
4. Describe what is happening in the diagram below. _____

_____

_____

_____

_____



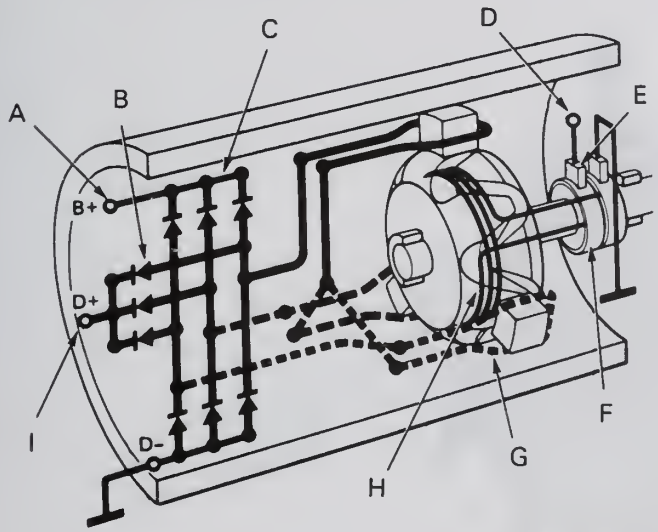
(Deere & Co.)

5. The _____ is a spinning magnetic field that fits in the center of the alternator housing.
6. The _____ is a stationary set of windings in the alternator that serves as the output winding of the alternator.
7. Alternator current must be _____ into direct current before entering the electrical system of a car.
8. A(n) _____ serves as a one-way check valve for electricity.
9. A(n) _____-_____ _____ means that both the positive and negative AC waves from the alternator stator are used to produce DC.

Name _____

ALTERNATOR OPERATIOIN (Continued)

10. Identify the parts indicated on the diagram of the alternator below.



(Robert Bosch)

A. _____
B. _____
C. _____
D. _____
E. _____
F. _____
G. _____
H. _____
I. _____

11. A(n) _____ _____ can be used to protect the diodes from overheating.

ALTERNATOR CONSTRUCTION

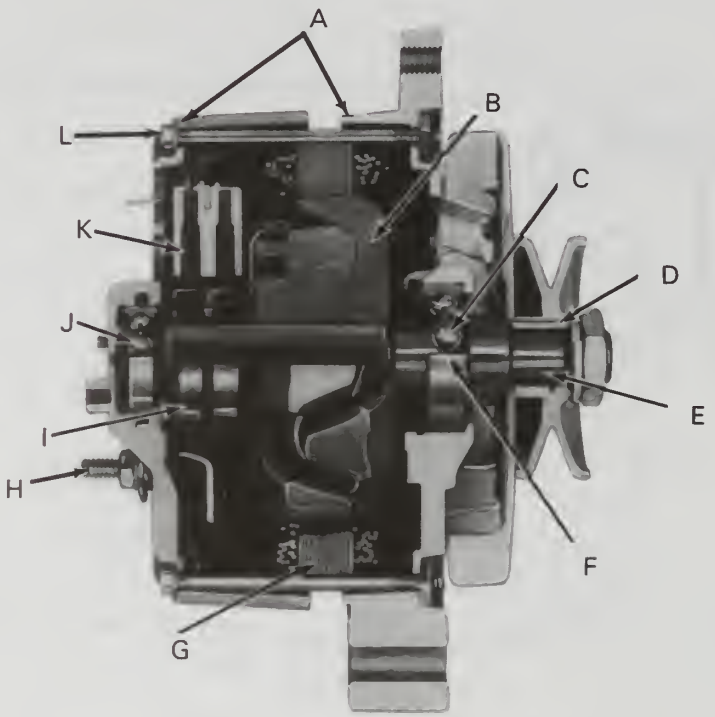
12. List the typical components of an alternator.

_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____

Name _____

ALTERNATOR CONSTRUCTION (Continued)

13. Identify the parts indicated on the photograph of the alternator below.



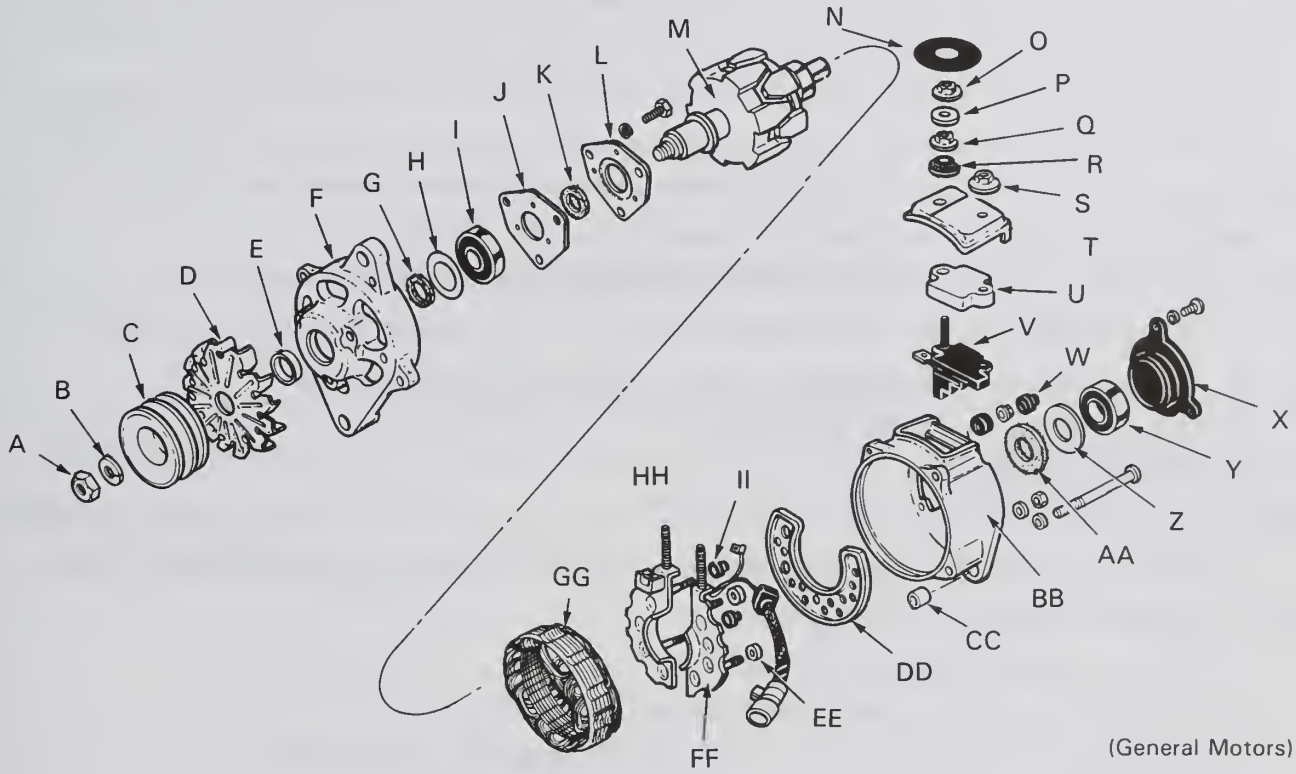
(Robert Bosch)

A. _____
B. _____
C. _____
D. _____
E. _____
F. _____
G. _____
H. _____
I. _____
J. _____
K. _____
L. _____

Name _____

ALTERNATOR CONSTRUCTION (Continued)

14. Identify the parts indicated on the diagram below.



(General Motors)

A. _____
B. _____
C. _____
D. _____
E. _____
F. _____
G. _____
H. _____
I. _____
J. _____
K. _____
L. _____
M. _____
N. _____
O. _____
P. _____
Q. _____
R. _____
S. _____
T. _____
U. _____
V. _____
W. _____
X. _____
Y. _____
Z. _____
AA. _____
BB. _____
CC. _____
DD. _____
EE. _____
FF. _____
GG. _____
HH. _____
II. _____

Name _____

VOLTAGE REGULATORS

15. Name the four basic types of voltage regulators.

    _____

    _____

    _____

    _____

16. The _____ voltage regulator, mounted inside or on the rear of the alternator, is the most common type of electronic regulator on today's cars.
17. Some newer electronic regulators are temperature compensating. This means:
    a. Output voltage is always increased.
    b. The regulator changes alternator output with outside temperatures.
    c. Output voltage is always decreased.
    d. None of the above.
18. _____ _____ _____ refers to how the voltage regulator can cycle the rotor field current on and off to control charging system output.
19. An alternator capacitor or condenser:
    a. Can be used to prevent radio noise.
    b. Absorbs alternating current inside the AC generator.
    c. Protects the rectifying diodes from high voltage spikes and damage.
    d. All of the above.
20. True or false? The contact point voltage regulator is an older type of regulator that has been replaced by electronic or solid state regulators.

COMPUTER-CONTROLLED VOLTAGE REGULATION

21. True or false? A conventional regulator is used to monitor the alternator's output in a computer-controlled voltage regulation system.
22. The duty cycle is the amount of time that current is fed to the alternator's _____ _____.

TYPES OF CHARGING SYSTEMS

23. Name two basic types of charging systems.

    _____

    _____

24. True or false? The DC generator has replaced the older alternator type charging system.

Name _____

CHARGE INDICATORS

25. Name and describe the three basic types of charge indicators.

_____

_____

_____

_____

_____

_____

ALTERNATOR VACUUM PUMP

26. An alternator vacuum pump is commonly used with _____ engines.

ALTERNATOR HIGH VOLTAGE

27. When the windshield heater element is activated, a control module switches the alternator to _____ _____ and sends the resulting high voltage output only to the windshield.

Chapter 15

IGNITION SYSTEMS

Name _____

Date _____ Period _____

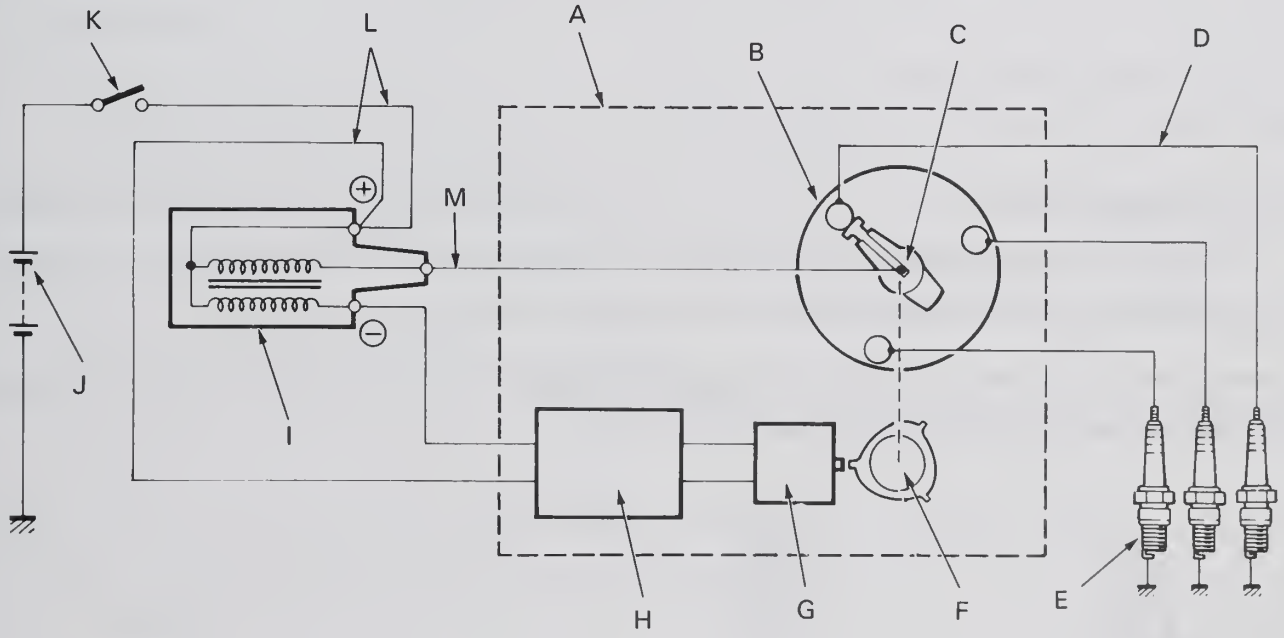
Instructor _____

OBJECTIVE: After studying this chapter, you will be able to describe various types of ignition systems and their functions.

INSTRUCTIONS: As you study the text, complete the workbook problems.

IGNITION SYSTEMS FUNDAMENTALS

1. Identify the basic parts of the ignition system shown below.



(General Motors)

A. _____

B. _____

C. _____

D. _____

E. _____

F. _____

G. _____

H. _____

I. _____

J. _____

K. _____

L. _____

M. _____

Name _____

IGNITION SYSTEMS FUNDAMENTALS (Continued)

2. True or false? Gasoline engines are compression ignition engines and do not need electronic ignition systems.
3. Name and describe the basic parts of an ignition system. _____

_____

_____

_____

_____

_____

_____

_____

_____

_____

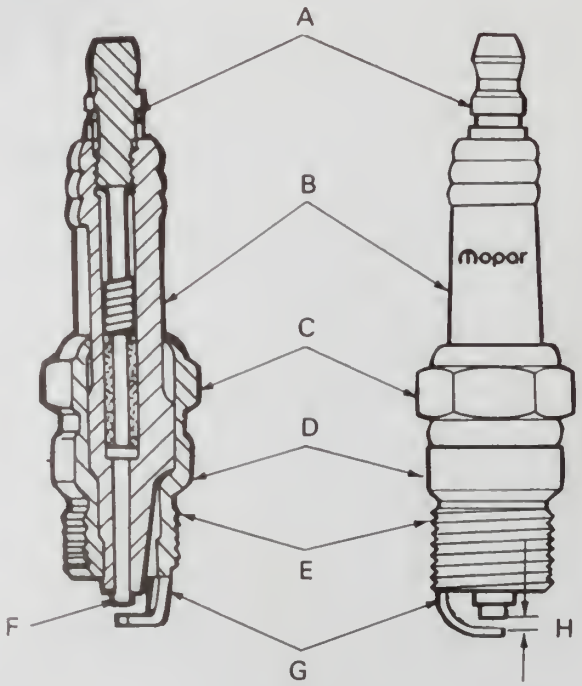
_____

_____

4. The ignition system's _____ (primary, secondary) circuit consists of all the components and wires operating on low voltage. The ignition system's _____ (primary, secondary) circuit includes all parts carrying high voltage.

SPARK PLUGS

5. Identify the parts indicated on the diagram below.



(Chrysler)

A. _____
B. _____
C. _____
D. _____
E. _____
F. _____
G. _____
H. _____

Name _____

SPARK PLUGS (Continued)

6. Which of the following is grounded and causes the electricity to jump the gap and return to the battery through the frame ground?
   a. Spark plug center terminal.
   b. Spark plug ceramic insulator.
   c. Spark plug side electrode.
   d. Spark plug shell.
7. The most common spark plug sizes are _____ mm and _____ mm. The smaller, _____ mm is replacing the larger _____ mm.
8. A(n) _____ spark plug helps prevent radiation of voltage that could upset operation of radios.
9. The _____ _____ _____ makes contact with the cylinder head to seal in the pressure of combustion, allowing heat to transfer out of the plug and into the head to prevent plug overheating and detonation.
10. The _____ _____ _____ is the distance between the end of the plug threads and the seat or sealing surface on the plug.
11. The _____ (long, short) spark plug insulator tip produces a colder running plug because more heat can transfer into the head.
12. Spark plug _____ is the distance or air space between the center and side electrodes.

SPARK PLUG WIRES

13. Spark plug wire boots protect the metal connectors from:
    a. Corrosion.
    b. Oil.
    c. Moisture.
    d. All of the above.

ENGINE FIRING ORDER

14. How is engine firing order determined? _____

_____

_____

_____

_____

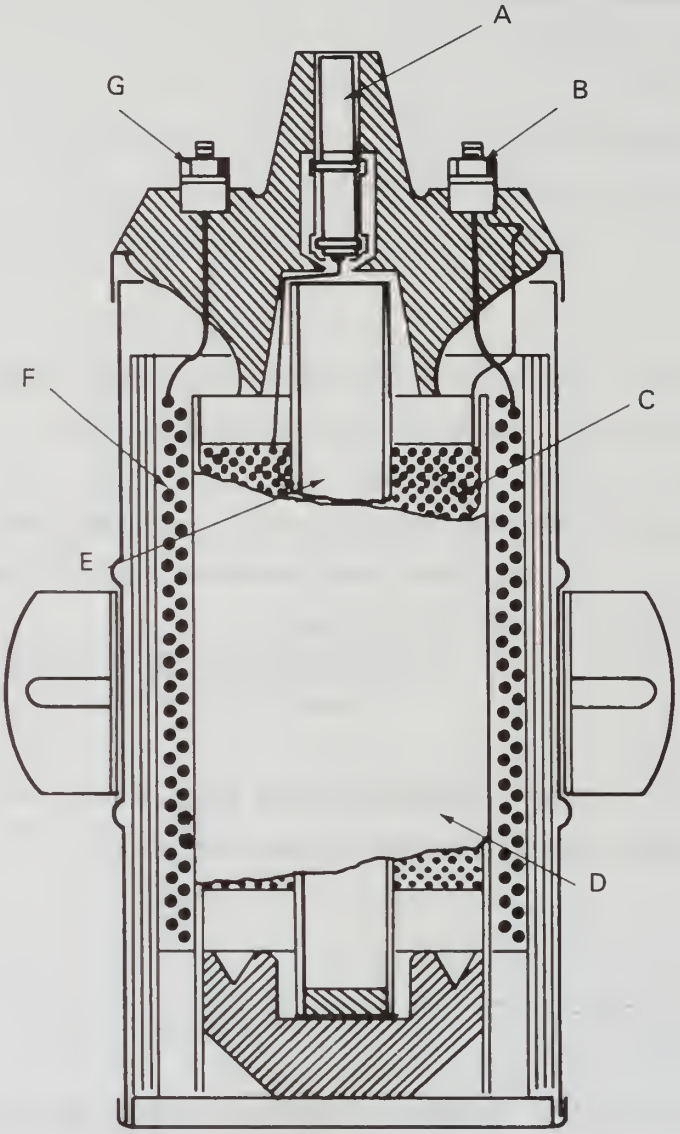
_____

_____

Name _____

IGNITION COIL

15. True or false? An ignition coil is a pulse-type transformer capable of producing a short burst of high voltage for starting combustion.
16. Identify the parts of the ignition coil below.



(Sun Electric)

A. _____ E. _____

B. _____ F. _____

C. _____ G. _____

D. _____

17. When battery current flows through the ignition coil primary windings, a strong _____ _____ is produced.

Name _____

IGNITION SYSTEM

18. True or false? Many electronic ignition systems do not use bypass or resistance circuits.
19. True or false? With a unitized distributor or distributorless ignition, a coil wire is needed.
20. The distributor _____ transfers voltage from the distributor cap center terminal to the distributor cap outer terminals and plug wires.

IGNITION DISTRIBUTORS

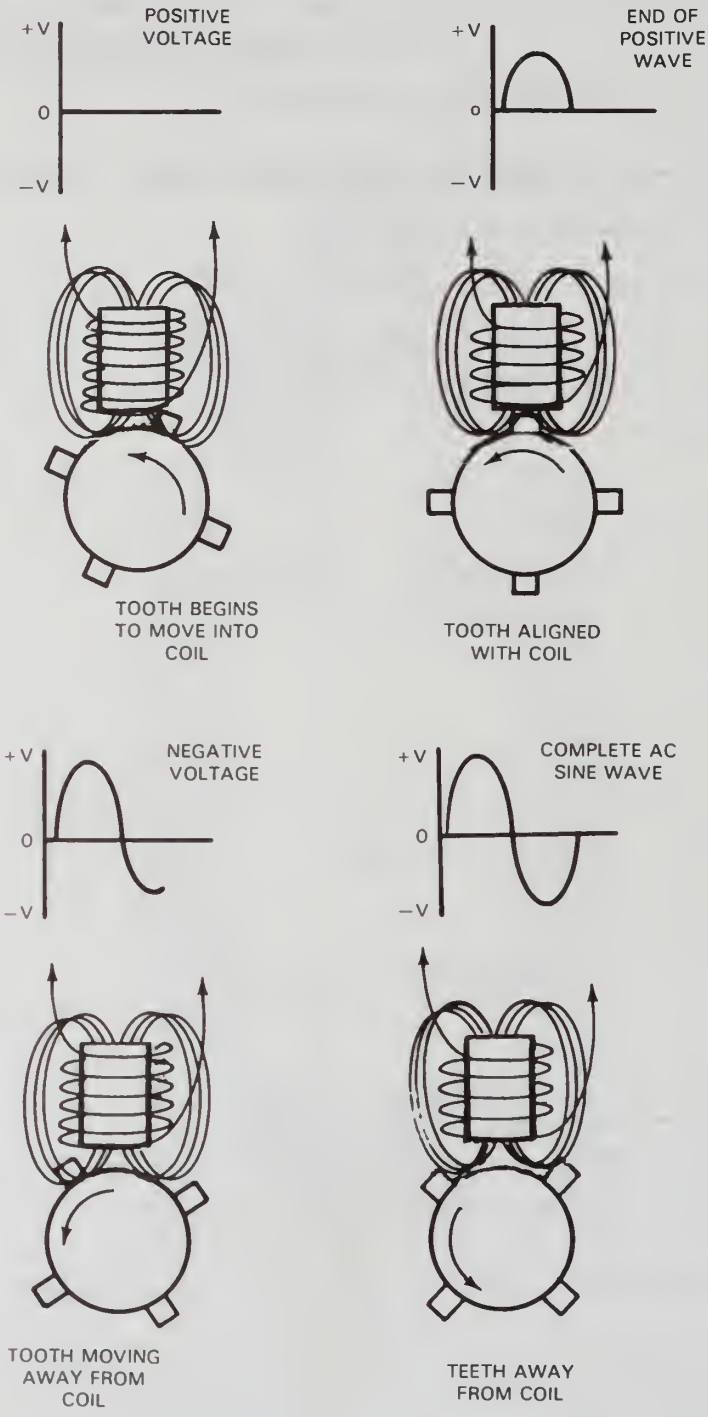
21. List six functions of an ignition distributor.

22. Name and describe four types of distributors.

Name _____

IGNITION DISTRIBUTORS (Continued)

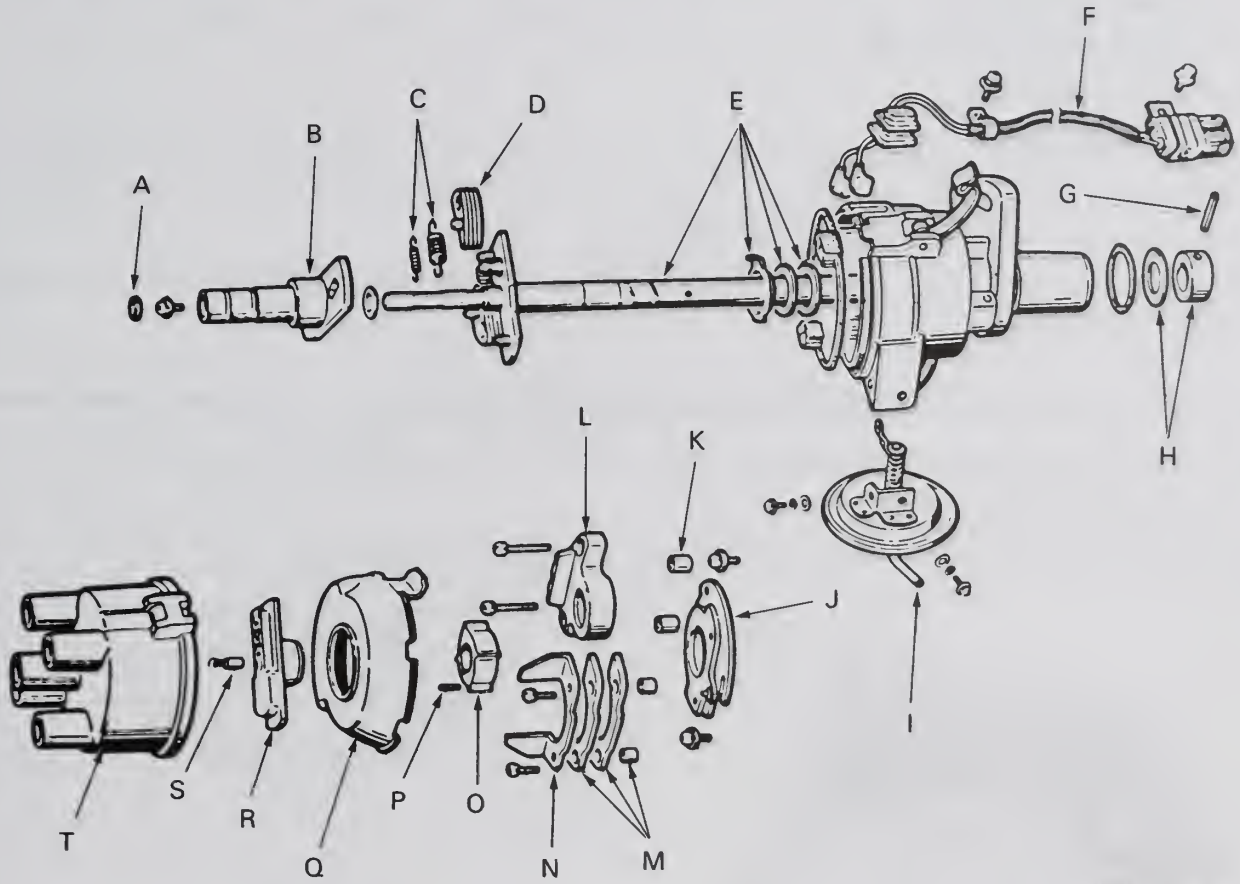
23. Look at the diagram below. Describe how a magnetic pickup coil operates.



Name _____

IGNITION DISTRIBUTORS (Continued)

24. Identify the parts indicated on the diagram of the distributor below.



(GM Trucks)

A. _____
B. _____
C. _____
D. _____
E. _____
F. _____
G. _____
H. _____
I. _____
J. _____
K. _____
L. _____
M. _____
N. _____
O. _____
P. _____
Q. _____
R. _____
S. _____
T. _____

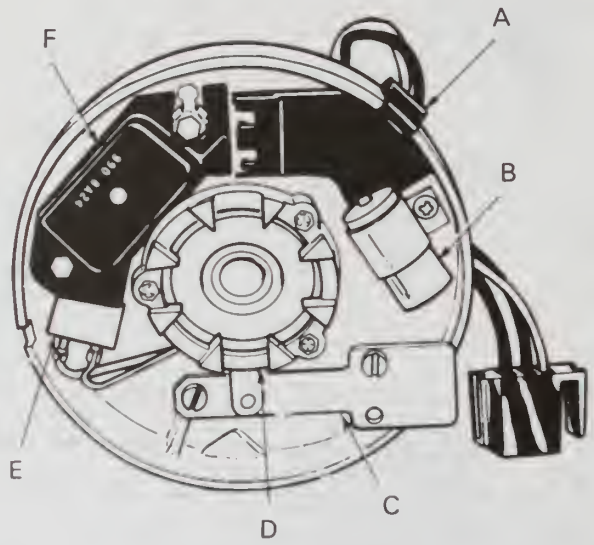
Name _____

IGNITION DISTRIBUTORS (Continued)

25. Which of the following is used to sense engine rpm?
    a. Speed pickup coil.
    b. Crank angle pickup coil.
    c. Start pickup coil.
    d. Run pickup coil.
26. A(n) _____ _____ pickup is a semiconductor switch that reacts to the movement of a trigger wheel with blades.
27. A distributor using a _____ type speed sensor can react to or "see" the flashing light from an LED.

ELECTRONIC IGNITION SYSTEM

28. An electronic ignition system uses an electronic control circuit and a(n) _____ pickup coil to operate the ignition coil.
29. Identify the parts indicated on the illustration of the distributor below.



(General Motors)

A. _____
B. _____
C. _____
D. _____
E. _____
F. _____

CONTACT POINT IGNITION SYSTEMS

30. True or false? Contact point ignition systems are common on cars produced today.

Name _____

IGNITION TIMING

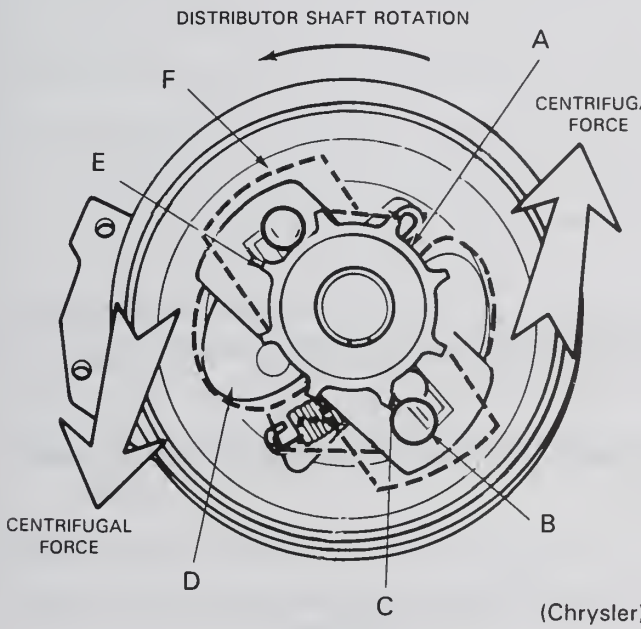
31. List the three basic methods used to control ignition system spark timing.

_____

_____

_____

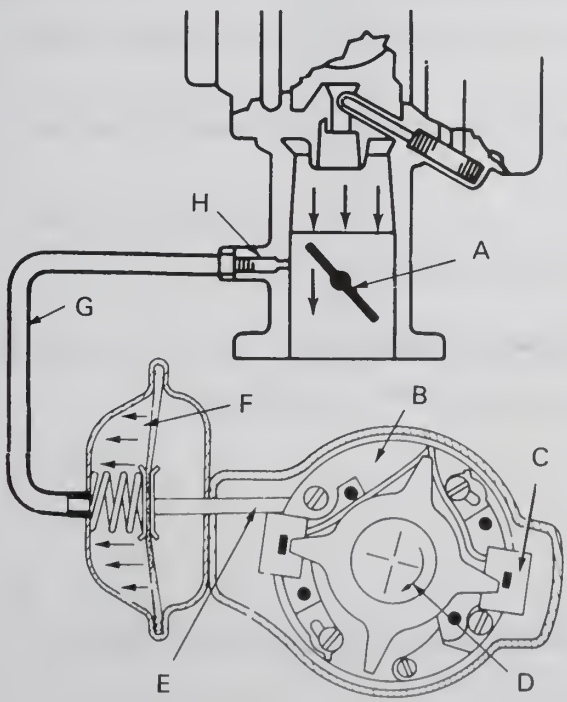
32. Identify what is indicated on the diagram of the distributor centrifugal advance below.



(Chrysler)

A. _____
B. _____
C. _____
D. _____
E. _____
F. _____

33. Identify what is indicated on the diagram of the distributor vacuum advance below.



(General Motors)

A. _____
B. _____
C. _____
D. _____
E. _____
F. _____
G. _____
H. _____

Name _____

IGNITION TIMING (Continued)

34. A dual-diaphragm vacuum advance mechanism is used on some _____ (newer, older) distributors.
35. List nine sensors that can affect the ignition system.

_____

_____

_____

_____

_____

_____

_____

_____

_____

36. The _____ _____ _____ is used to retard ignition timing and, sometimes, turbocharger boost pressure during periods of engine knock, ping, or spark knock.
37. A(n) _____ knock sensing system sends a low-voltage discharge across the spark plug gaps to help analyze combustion efficiency.
38. A(n) _____ _____ _____ can be used to limit maximum engine speed or rpm by operating a governor solenoid or by partially shutting off the engine system.

CRANKSHAFT TRIGGERED IGNITION

39. True or false? A crankshaft triggered ignition system places the pickup coil and trigger wheel (pulse ring) unit on the front of the engine.
40. A(n) _____ _____ is usually mounted on the crankshaft damper to provide engine speed information to the pickup unit.
41. The _____ _____ _____ is mounted next to the crank pulse ring and sends electrical pulses to the system computer or ECU.

COMPUTER-COIL (DISTRIBUTORLESS) IGNITION

42. A computer-coil ignition uses which of the following to operate the spark plugs?
    a. Multiple ignition coils and a coil control unit.
    b. Distributor.
    c. Engine sensors and a computer.
    d. Both a and c above.
43. True or false? The distributorless ignition system uses conventional spark plug wires instead of conductor strips.

Name _____

COMPUTER-COIL (DISTRIBUTORLESS) IGNITION (Continued)

44. List five advantages a distributorless ignition system has over ignition systems with a distributor.

_____

_____

_____

_____

_____

_____

_____

_____

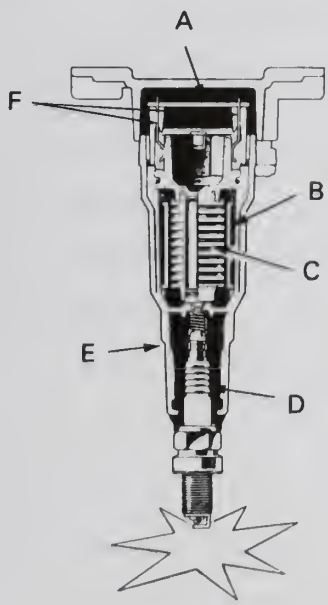
_____

_____

DIRECT IGNITION SYSTEM

45. True or false? No plug wires or conductor strips are needed in direct ignition systems.

46. Identify the parts indicated on the diagram of the ignition coil for a direct ignition system shown below.



(Saab)

A. _____

B. _____

C. _____

D. _____

E. _____

F. _____

Chapter 16

FUEL AND EMISSION CONTROL SYSTEM ELECTRONICS

Name _____

Date _____ Period _____

Instructor _____

OBJECTIVE: After studying this chapter, you will be able to describe the role of fuel and emission control systems electronics in automobiles.

INSTRUCTIONS: As you study the text, complete the workbook problems.

FUEL SYSTEM TYPES

1. Name and describe three common types of fuel system classifications.

_____

_____

_____

_____

_____

_____

ELECTRONIC GASOLINE INJECTION

2. The electronic gasoline injection is replacing the electronic or computer controlled _____.
3. True or false? Multi-point fuel injection is more common and is replacing single-point fuel injection on most car models.
4. Name and describe the three basic classifications of gasoline injection timing.

_____

_____

_____

_____

_____

_____

_____

_____

_____

Name _____

ELECTRONIC GASOLINE INJECTION (Continued)

5. Which of the following types of injectors has the injectors opening one after the other?
   a. Group.
   b. Sequential.
   c. Simultaneous.
   d. None of the above.

FUEL SYSTEM SUB-SYSTEMS

6. Name and describe the three types of fuel system sub-systems.

_____

_____

_____

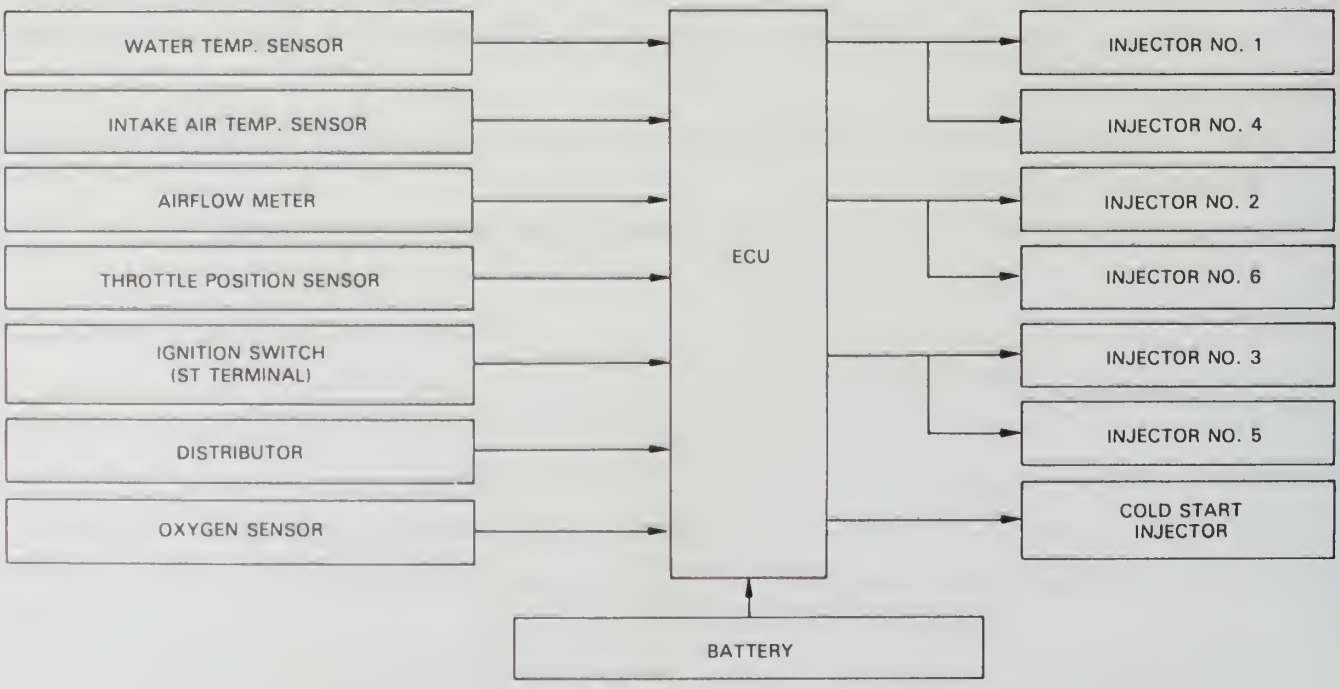
_____

_____

_____

FUEL SYSTEM DIAGRAMS AND SCHEMATICS

7. In the block diagram below, the _____ (actuators, sensors) are on the right.



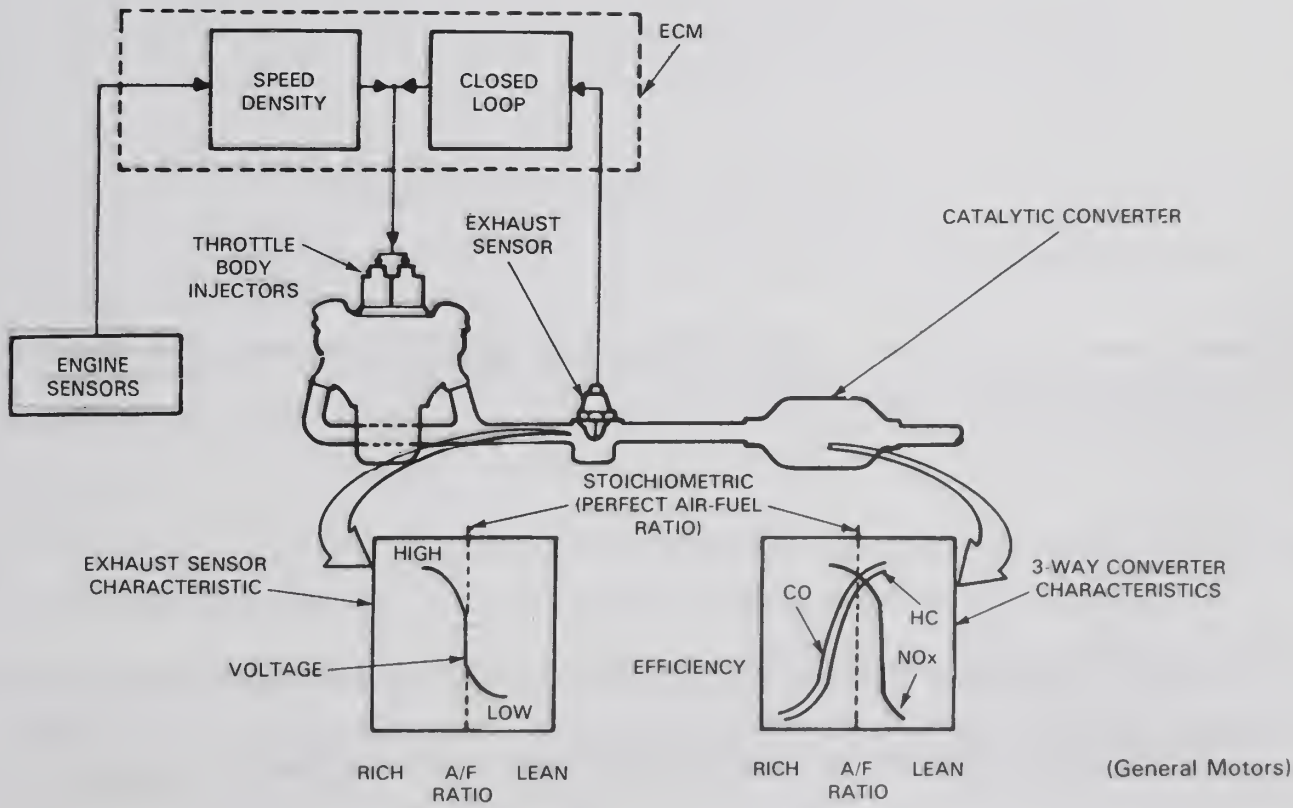
Name _____

FUEL SYSTEM DIAGRAMS AND SCHEMATICS (Continued)

8. True or false? A fuel system diagram usually shows the exact electrical wiring.
9. A fuel system _____ is a very detailed circuit drawing using symbols to represent components and lines to represent wires.

OPEN LOOP AND CLOSED LOOP

10. Describe what is happening in the diagram below. _____



(General Motors)

Name _____

FUEL BACK-UP MODE

11. What is the purpose of the fuel back-up mode? _____

GASOLINE INJECTORS

12. Name and describe the eight basic parts of a gasoline injector.

INJECTOR PULSE WIDTH

13. What is the injector pulse width? _____

14. Look at the graph on page 149. The top line on the graph represents the engine _____ _____.

List the sensor conditions that increase graph height and fuel richness.

A. _____

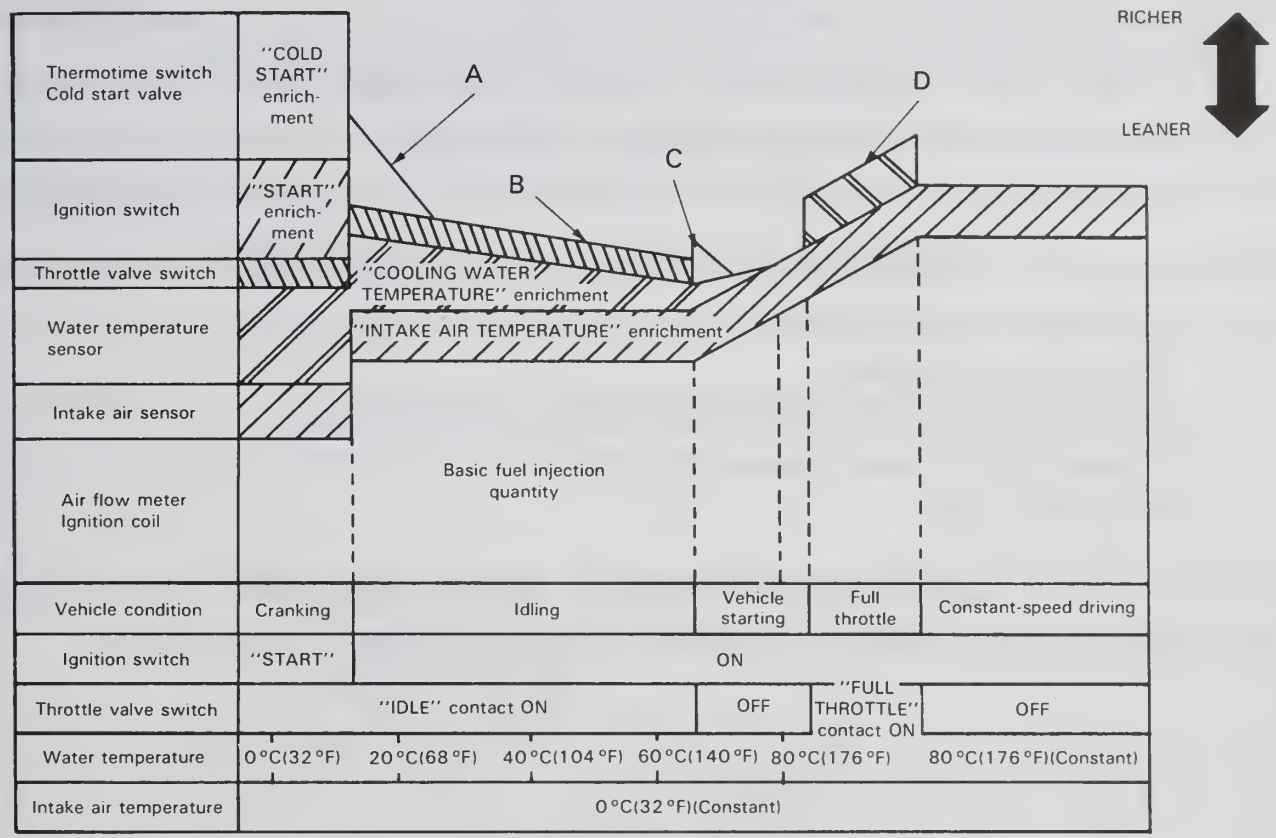
B. _____

C. _____

D. _____

Name _____

INJECTOR PULSE WIDTH (Continued)



AIR-ASSISTED FUEL INJECTION

15. True or false? An air-assisted fuel injection system allows crankcase gases to be drawn into the injectors, improving fuel atomization.

IDLE AIR CONTROL VALVE

16. When open, the idle air control valve allows more air to enter the intake manifold which tends to _____ (decrease, increase) engine idle rpm.

IDLE SPEED SOLENOID

17. True or false? An idle speed solenoid is frequently used on carburetors.

IDLE SPEED MOTOR AND ELECTRIC CHOKE

18. True or false? An idle speed monitor is used on a carburetor to control the choke opening right after cold engine starting.

Name _____

SOLENOID BOWL VENT

19. Upon engine restarting, the solenoid bowl vent usually _____ (closes, opens) and the vapors are drawn out of the canister and back into the engine for burning.

FUEL SHUT-OFF SOLENOID

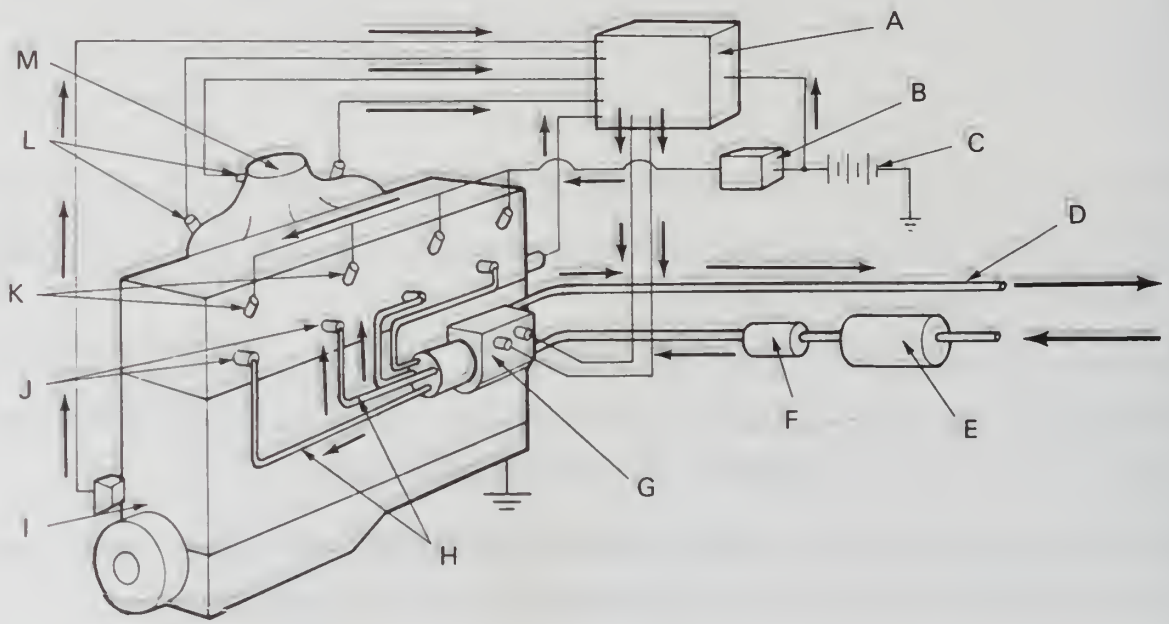
20. True or false? A fuel shut-off solenoid improves fuel economy and decreases exhaust emissions.

COMPUTER-CONTROLLED CARBURETORS

21. In a computer controlled carburetor, the air-fuel ratio is maintained by:
    a. Remaining on constantly.
    b. Cycling the mixture solenoid on and off several times per second.
    c. Remaining off for several minutes at a time.
    d. None of the above.

COMPUTER-CONTROLLED DIESEL INJECTION

22. Identify the parts indicated on the electronic diesel injection system shown below.



A. _____
B. _____
C. _____
D. _____
_____
_____
_____

H. _____
I. _____
J. _____
K. _____
L. _____
M. _____

Name _____

ELECTRIC FUEL PUMPS

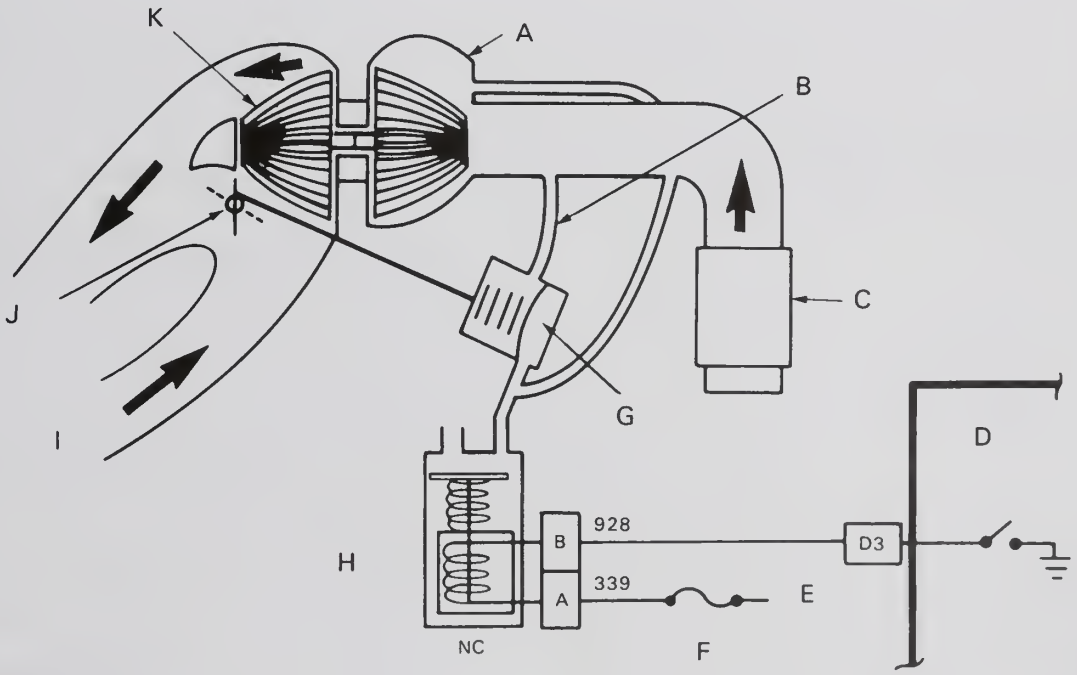
23. An electric fuel pump provides _____ (delayed, instant) fuel pressure upon engine cranking.

EMISSION CONTROL ELECTRONICS

24. Which of the following are electronically-controlled emission control systems?
    a. Computer-controlled catalytic converter.
    b. Electronically-controlled EGR.
    c. Electronic fuel evaporation control.
    d. All of the above.

ELECTRONIC TURBOCHARGER CONTROL

25. Identify the parts indicated on the diagram below.



(General Motors)

A. _____
B. _____
C. _____
D. _____
E. _____
F. _____
G. _____
H. _____
I. _____
J. _____
K. _____

Chapter 17

LIGHTING SYSTEMS, INSTRUMENTATION

Name _____

Date _____ Period _____

Instructor _____

OBJECTIVE: After studying this chapter, you will be able to describe various types of lighting systems and instrumentation and explain how they operate.

INSTRUCTIONS: As you study the text, complete the workbook problems.

LIGHTING SYSTEMS

1. List six components of a lighting system.

_____

_____

_____

_____

_____

_____

2. A(n) _____ switch is used to change from low to high or high to low headlight beams.

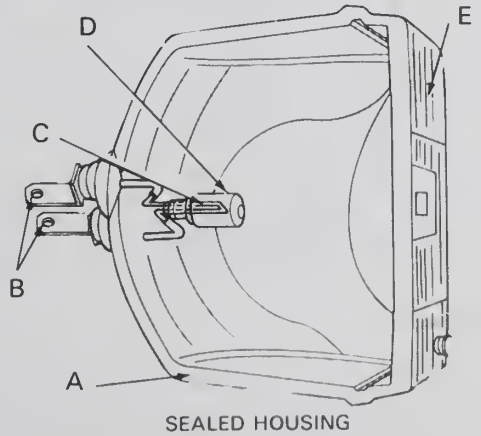
3. Name three types of headlamp beams.

_____

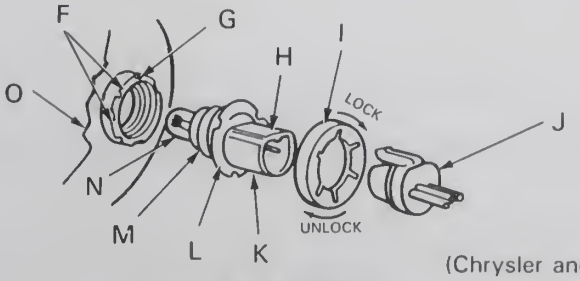
_____

_____

4. Identify the parts indicated on the diagram below.



SEALED HOUSING



HALOGEN BULB INSERT

(Chrysler and Ford)

A. _____

B. _____

C. _____

D. _____

E. _____

F. _____

G. _____

H. _____

I. _____

J. _____

K. _____

L. _____

M. _____

N. _____

O. _____

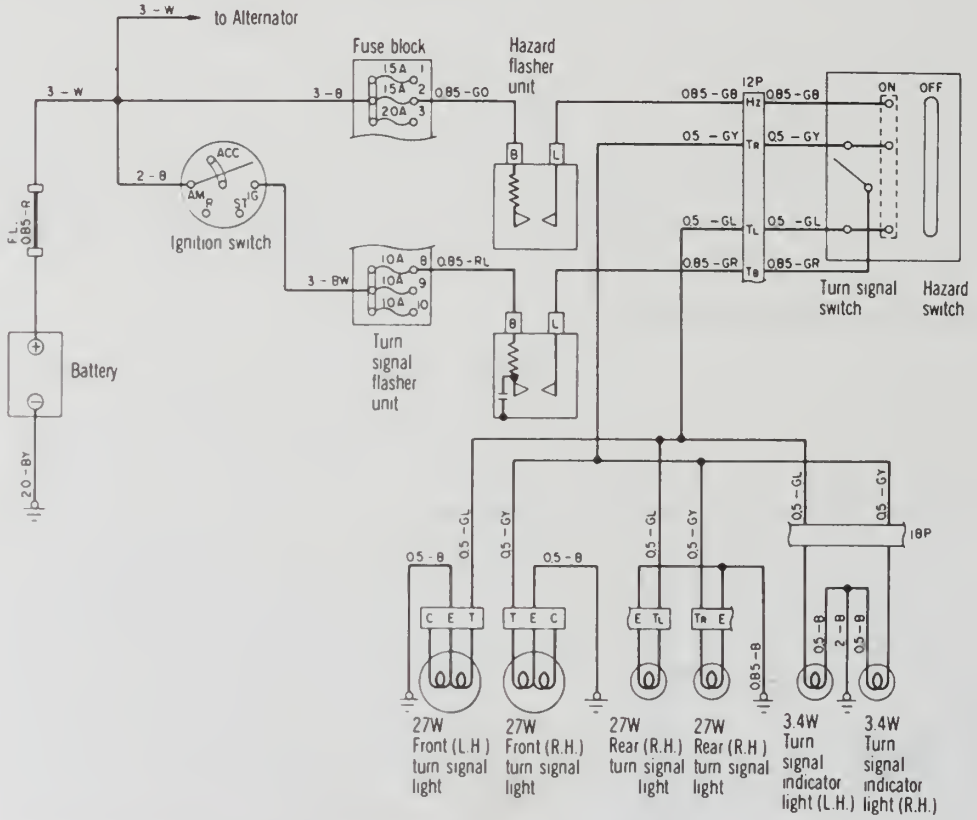
Name _____

LIGHTING SYSTEMS (Continued)

5. _____ headlamps use a vacuum or electric motor setup to swing the headlamps or headlamp doors up or down in the car body.
6. An autolamp system uses which of the following to automatically control headlamp operation?
   a. Light sensor.
   b. Control circuit and switch.
   c. Relay.
   d. All of the above.

TURN, EMERGENCY, STOPLIGHTS

7. Study this turn signal and hazard warning light circuit. Locate the two flasher units and, using a colored pencil, show how they wire into the circuit.



(Chrysler)

8. Name the components of the emergency flasher system.

_____

_____

_____

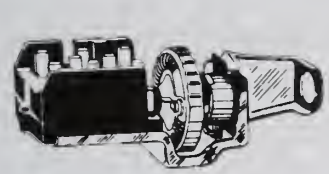
_____

9. True or false? The brake light switch is normally mounted on or near the brake pedal.
10. The _____ light system uses a dash switch and door switches to operate small lights inside the passenger compartment.

Name _____

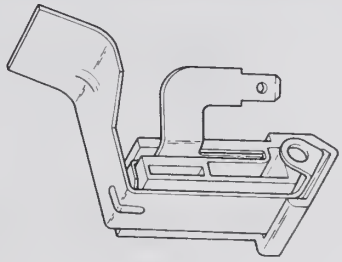
LIGHT AND INSTRUMENTATION SWITCHES

11. Identify the various switches used in light and instrumentation systems.

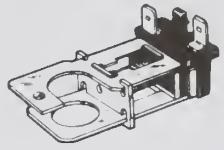


A

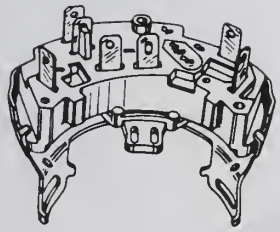
B



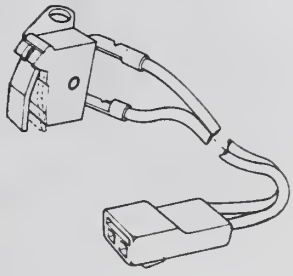
C



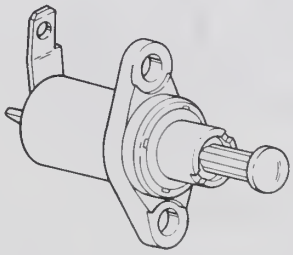
D



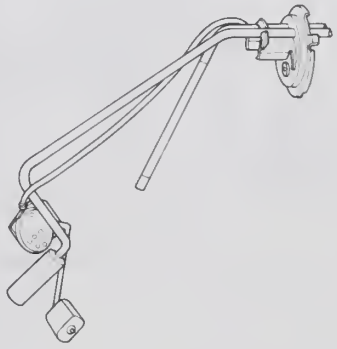
E



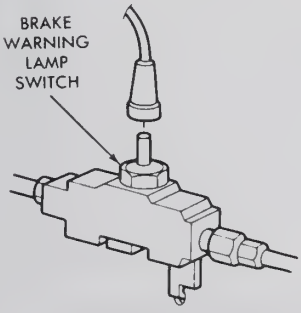
F



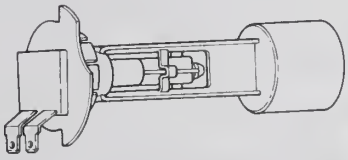
G



H

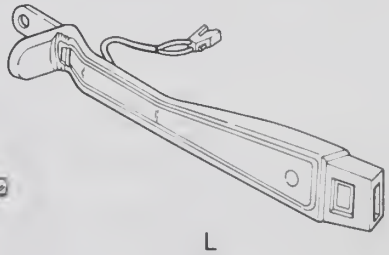


I



J

K



L

(GP Parts and Chrysler)

A. _____
B. _____
C. _____
D. _____
E. _____
F. _____
G. _____
H. _____
I. _____
J. _____
K. _____
L. _____

Name _____

INSTRUMENTATION GAUGES

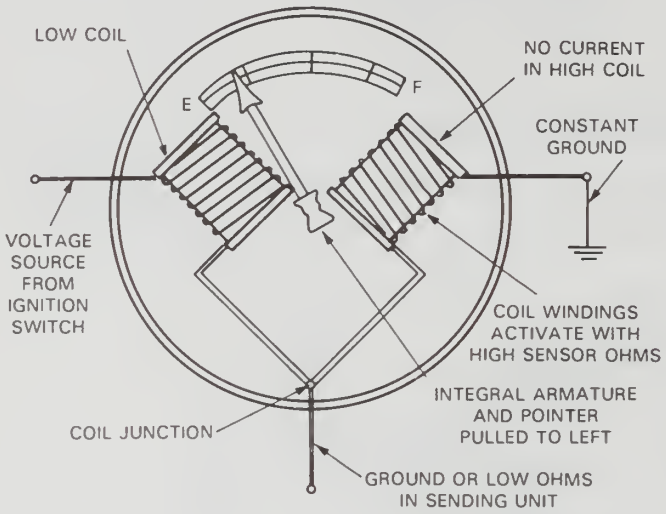
12. Gauges give warning _____ (after, before) engine damage occurs.

13. Identify the types of gauges shown below.

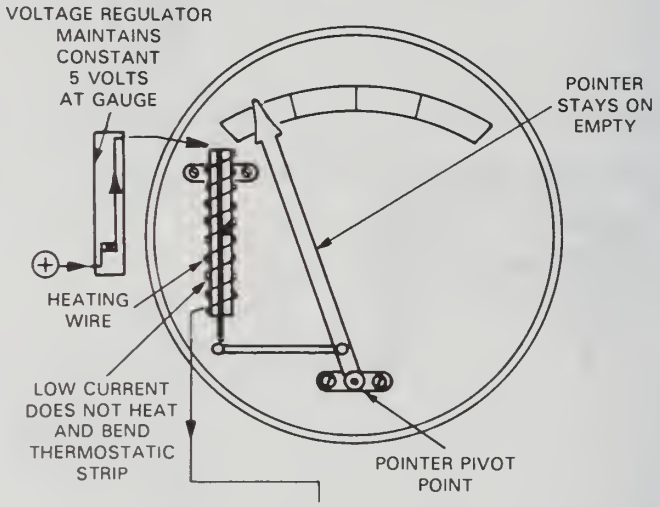
A. _____

B. _____

A



B


VOLTAGE REGULATOR MAINTAINS CONSTANT 5 VOLTS AT GAUGE
POINTER STAYS ON EMPTY
HEATING WIRE
LOW CURRENT DOES NOT HEAT AND BEND THERMOSTATIC STRIP
POINTER PIVOT POINT

14. Identify the parts indicated on the basic temperature gauge circuit below.

A. _____

B. _____

C. _____

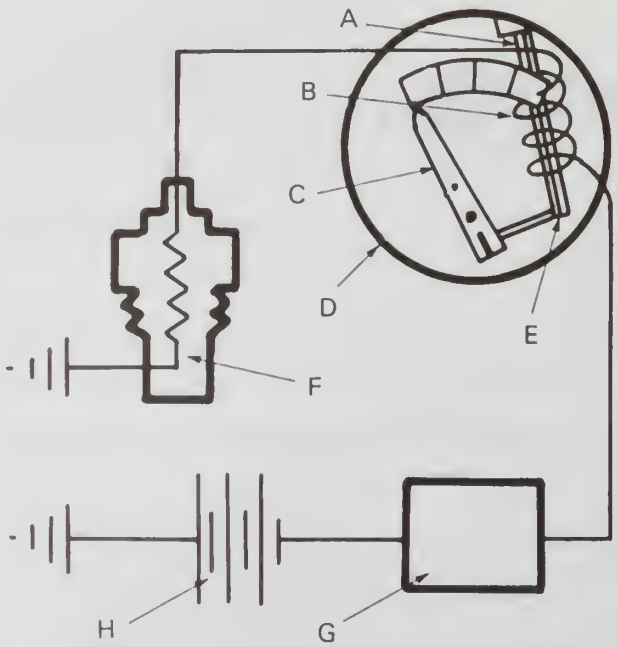
D. _____

E. _____

F. _____

G. _____

H. _____

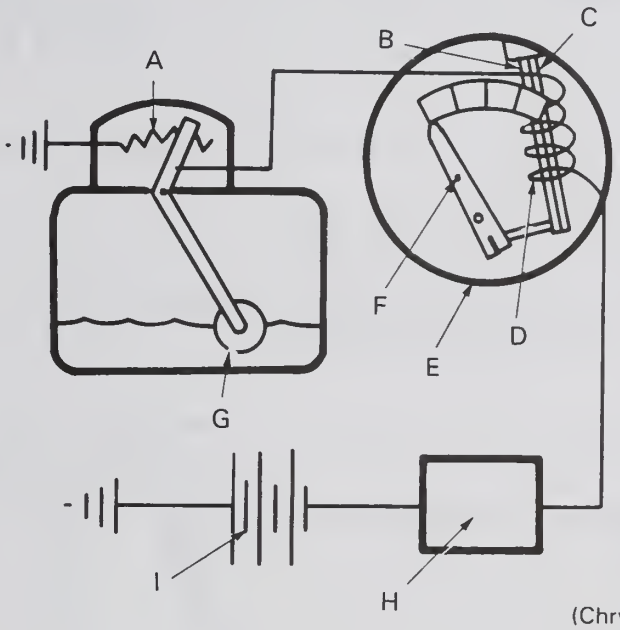


(Chrysler)

Name _____

INSTRUMENTATION GAUGES (Continued)

15. Identify the parts indicated on the fuel gauge circuit below.



(Chrysler)

A. _____ F. _____

B. _____ G. _____

C. _____ H. _____

D. _____ I. _____

E. _____

16. A(n) _____ _____ _____ uses the vehicle speed sensor, fuel flow sensor or tank sending unit, engine control computer, and possibly other inputs to show average fuel consumption and miles-to-empty displays.
17. A low fuel warning light circuit can use either a control _____ or extra _____ mounted on the fuel tank sending unit.
18. When the charging system is in good condition, the _____ should register around 13 to 15 volts.
19. True or false? The oil pressure gauge circuit uses a variable resistance sending unit to operate a needle type gauge.
20. A(n) _____ circuit is commonly used in the low oil level indicator system to prevent the indicator light from flashing on and off as the oil splashes around inside the oil pan.
21. The _____ uses the pulsing voltage or current going to the ignition coil to operate the indicator showing engine rpm.

Name _____

INSTRUMENT CLUSTER CONSTRUCTION

22. The instrument cluster houses:
    a. Most of the dash gauges.
    b. The speedometer.
    c. The indicator lights.
    d. All of the above.
23. A digital instrument cluster uses:
    a. Analog type gauges.
    b. Needle type gauges.
    c. Computer-driven number or graphic displays.
    d. None of the above.
24. True or false? An electronic speedometer uses a speedometer cable.
25. A(n) _____ _____ system uses an electronic circuit to drive a speaker for verbally explaining conditions to the driver.

Chapter 18

WIPER AND HORN SYSTEMS

Name _____

Date _____ Period _____

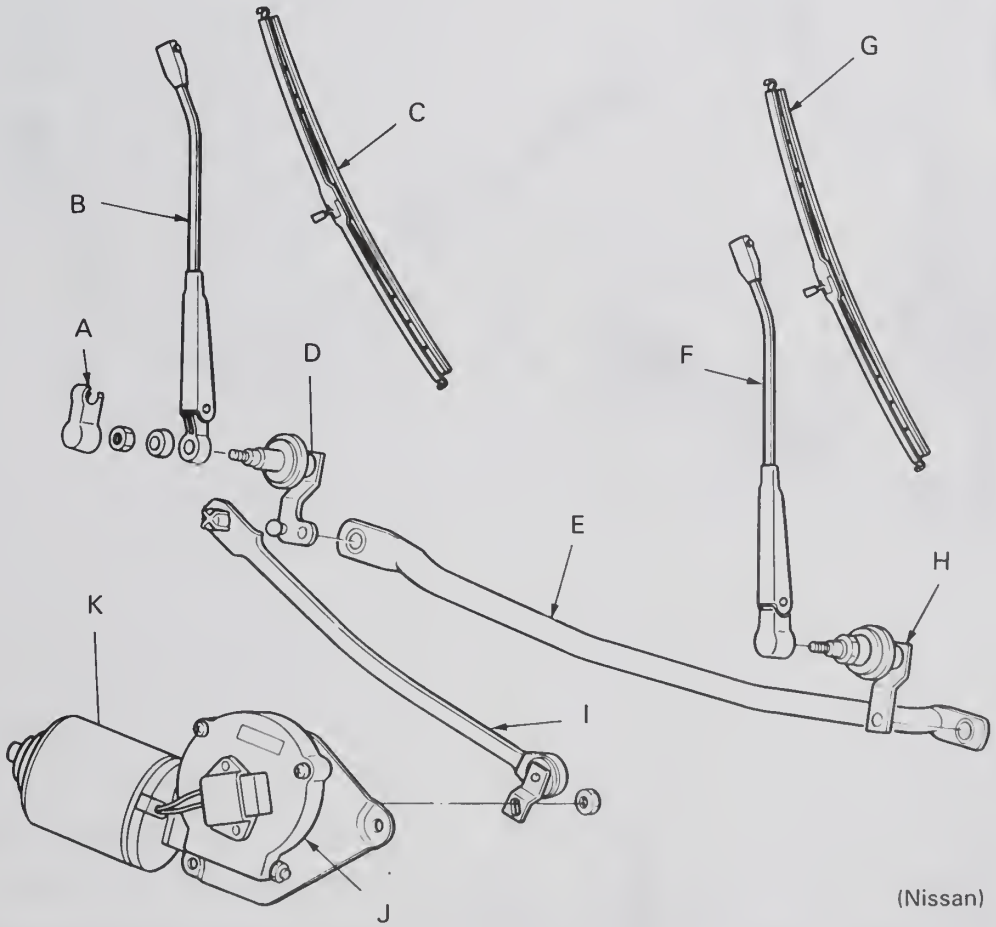
Instructor _____

OBJECTIVE: After studying this chapter, you will be able to describe how various wiper and horn systems operate.

INSTRUCTIONS: As you study the text, complete the workbook problems.

WINDSHIELD WIPER SYSTEM

1. Identify the basic parts of the windshield wiper system below.



(Nissan)

A. _____

B. _____

C. _____

D. _____

E. _____

F. _____

G. _____

H. _____

I. _____

J. _____

K. _____

Name _____

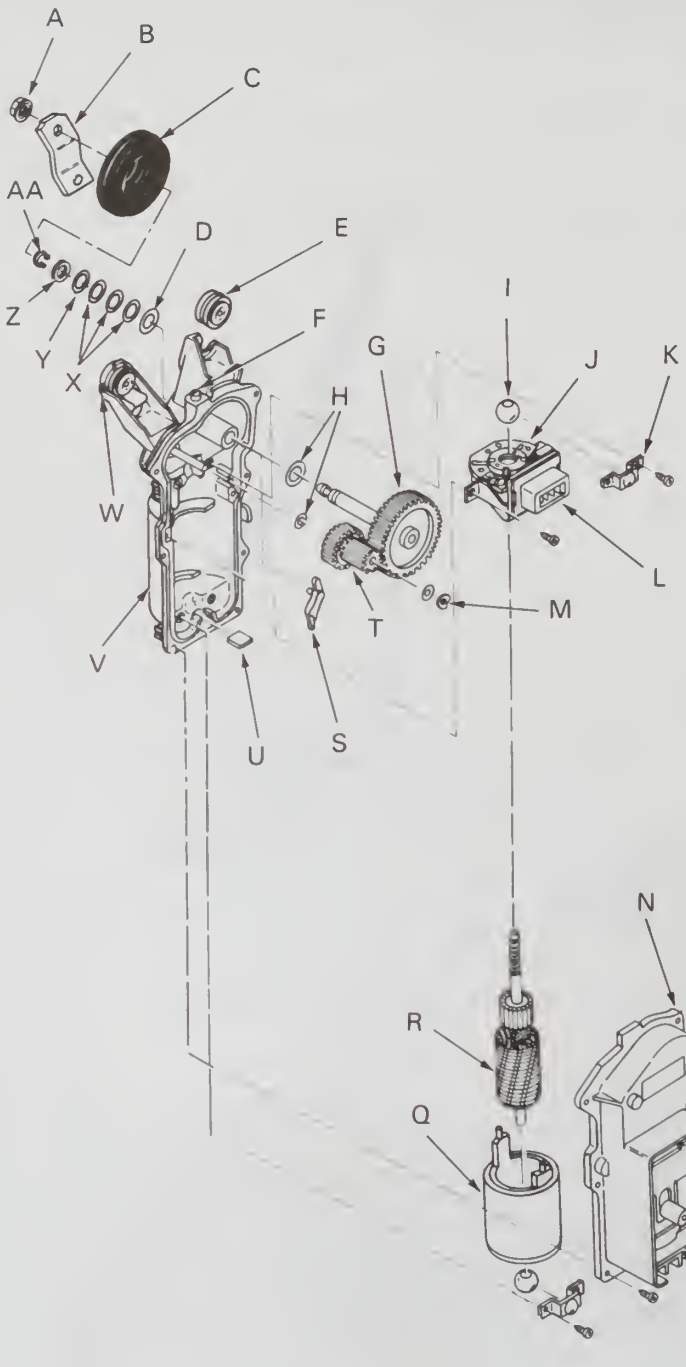
WINDSHIELD WIPER SYSTEM (Continued)

2. What part does the worm gear play in wiper operation?

_____

_____

3. Identify the parts indicated on the wiper motor below.



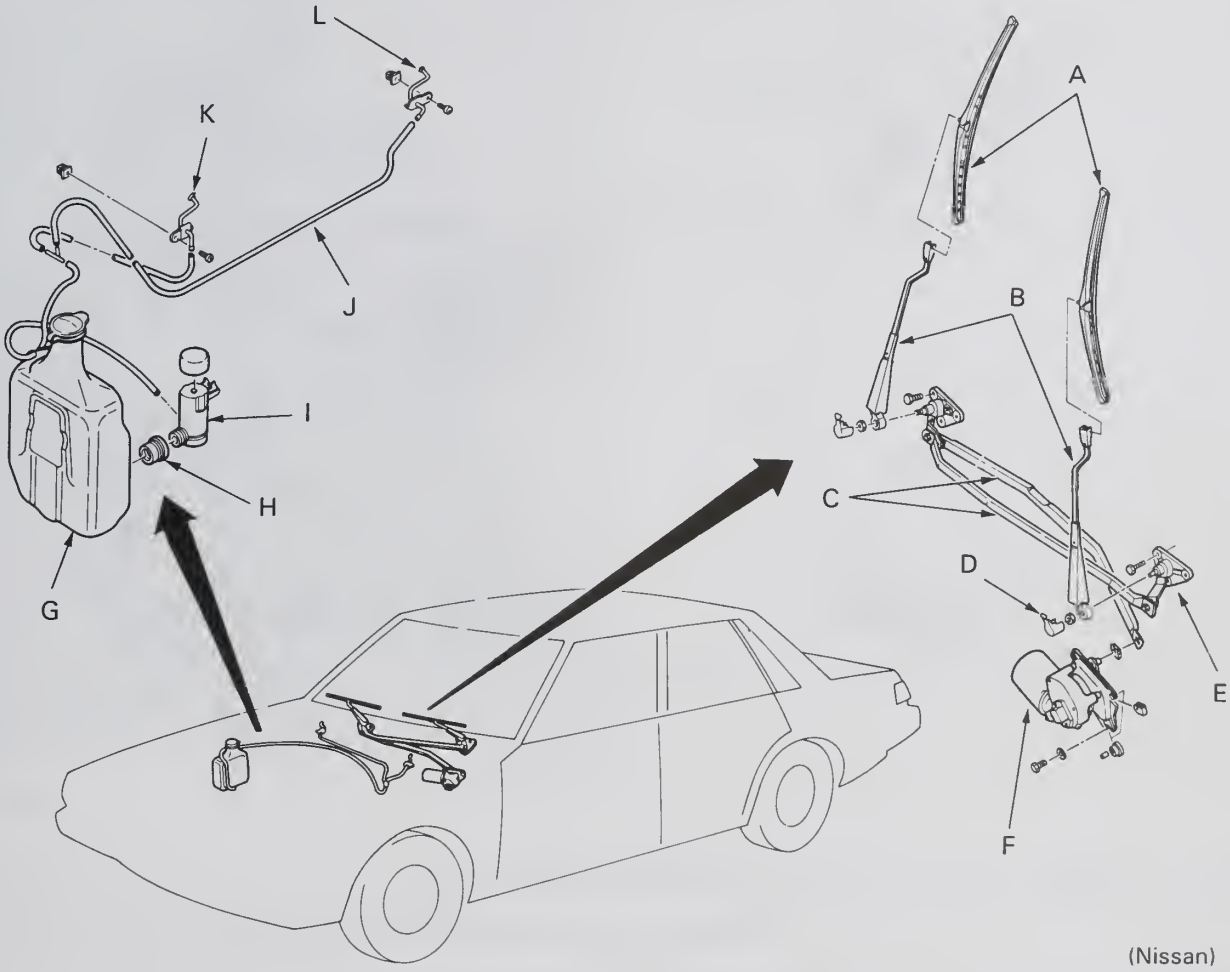
A. _____
B. _____
C. _____
D. _____
E. _____
F. _____
G. _____
H. _____
I. _____
J. _____
K. _____
L. _____
M. _____
N. _____
O. _____
P. _____
Q. _____
R. _____
S. _____
T. _____
U. _____
V. _____
W. _____
X. _____
Y. _____
Z. _____
AA. _____

(General Motors)

Name _____

WINDSHIELD WASHER SYSTEM

4. Identify the parts indicated on the diagram of the windshield washer system shown below.



(Nissan)

A. _____ G. _____

B. _____ H. _____

C. _____ I. _____

D. _____ J. _____

E. _____ K. _____

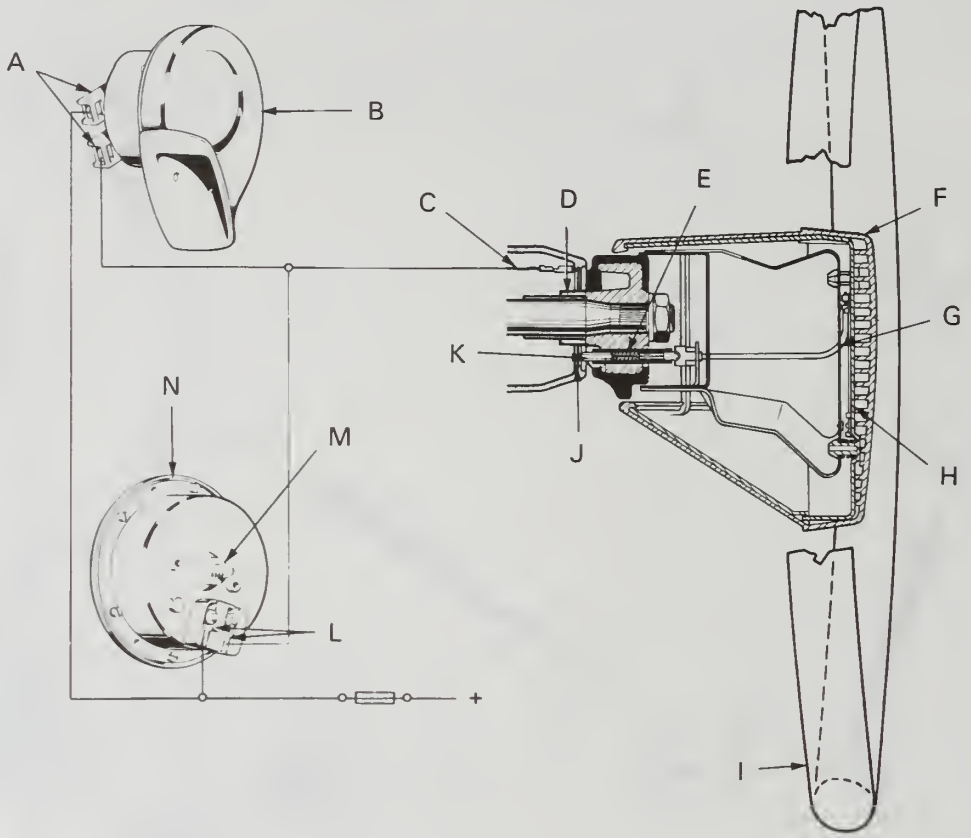
F. _____ L. _____

5. Which type of washer pump is used most often in windshield washer systems?
   a. Electric motor washer pump.
   b. Mechanical washer pump.
   c. Reciprocating washer pump.
   d. None of the above.
6. A windshield washer system with a pulse or delay wiper feature commonly uses a(n) _____ _____ to control the delay action.

Name _____

HORN SYSTEM

7. Identify the parts indicated on the horn system below.



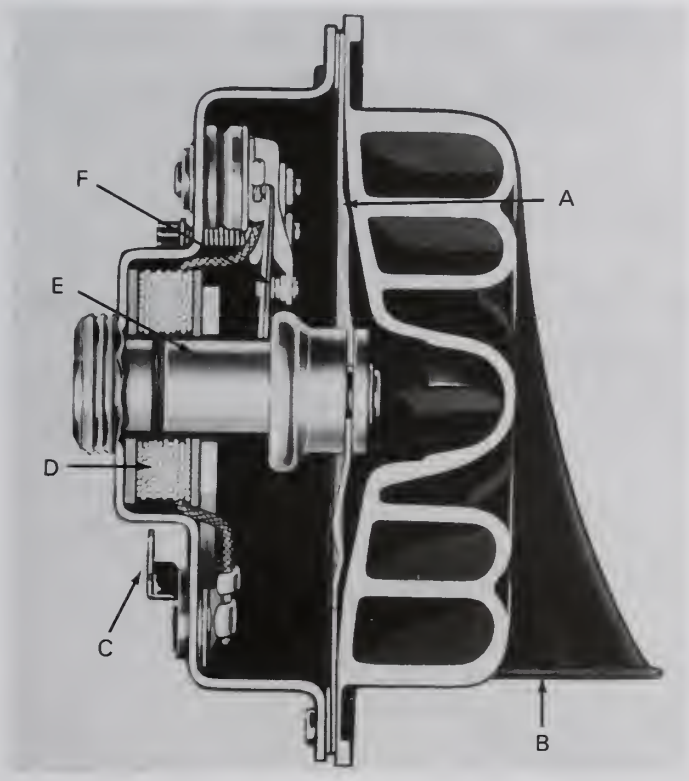
(Saab)

A. _____
B. _____
C. _____
D. _____
E. _____
F. _____
G. _____
H. _____
I. _____
J. _____
K. _____
L. _____
M. _____
N. _____

Name _____

HORN SYSTEM (Continued)

8. Identify the parts indicated on the diagram of the internal structure of the horn below.



(Deere & Co.)

A. _____
B. _____
C. _____
D. _____
E. _____
F. _____

9. A horn _____ is sometimes used between the horn switch and the horns to reduce the amount of current flowing through the horn switch.

THEFT DETERRENT SYSTEM

10. Explain how a theft deterrent system works.

_____

_____

_____

_____

Chapter 19

SEAT, WINDOW, LOCK, MIRROR, AND SOUND SYSTEMS

Name _____

Date _____ Period _____

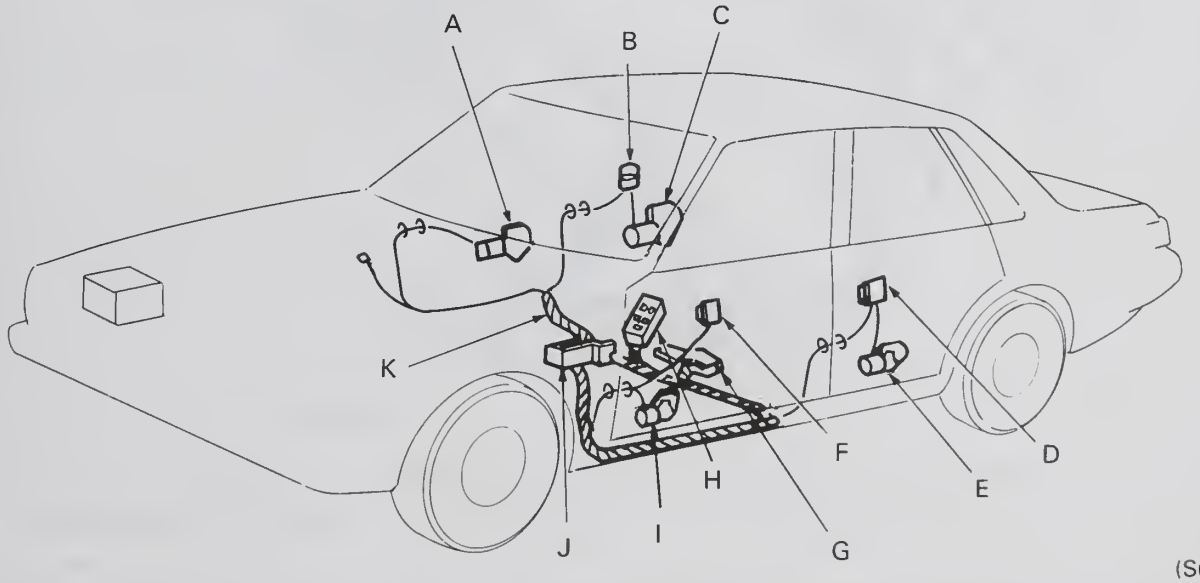
Instructor _____

OBJECTIVE: After studying this chapter, you will be able to describe how seat, window, lock, mirror, and sound systems operate.

INSTRUCTIONS: As you study the text, complete the workbook problems.

POWER WINDOWS

1. Identify the parts indicated on the diagram of the power window system shown below.



(Subaru)

A. _____

B. _____

C. _____

D. _____

E. _____

F. _____

G. _____

H. _____

I. _____

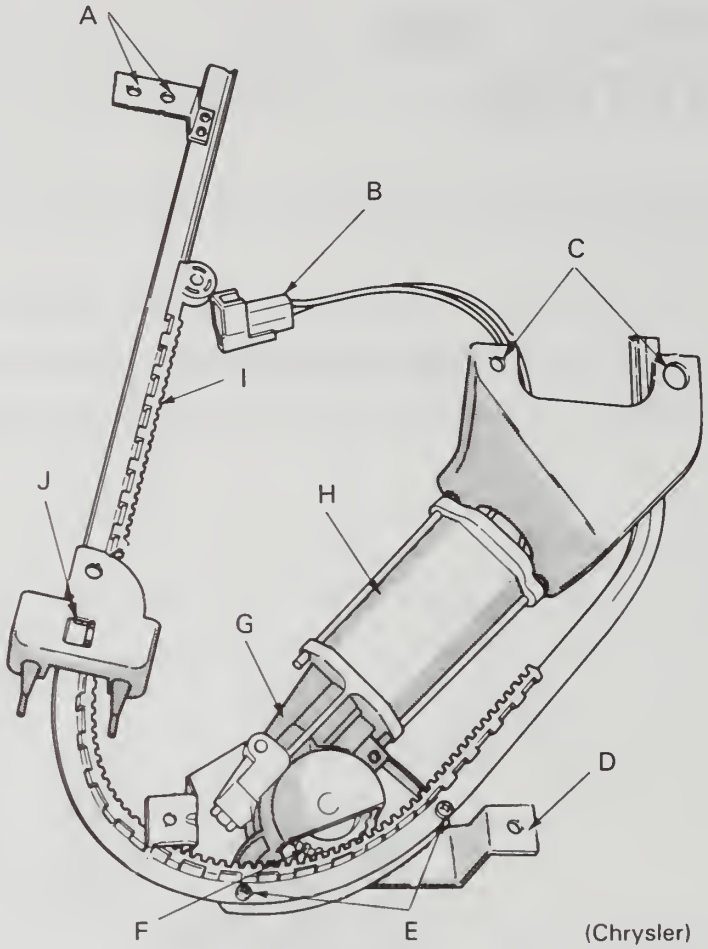
J. _____

K. _____

Name _____

POWER WINDOWS (Continued)

2. Identify the parts indicated on the diagram below.



(Chrysler)

A. _____ F. _____

B. _____ G. _____

C. _____ H. _____

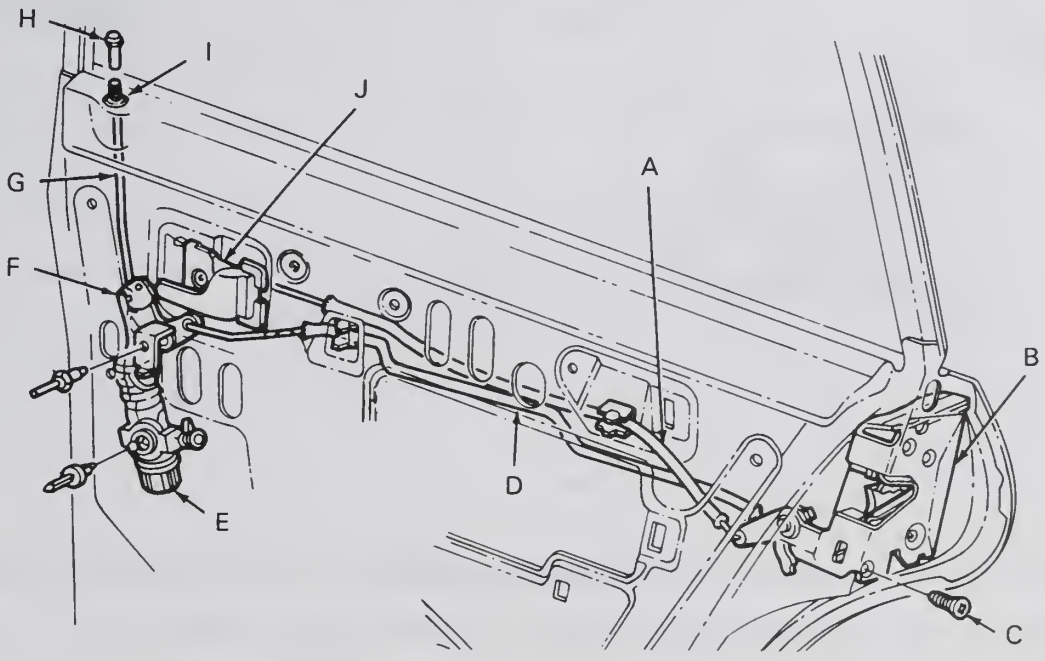
D. _____ I. _____

E. _____ J. _____

Name _____

POWER DOOR LOCKS

3. Identify the parts indicated on the diagram of the power door lock mechanism below.



(Ford)

A. _____ F. _____

B. _____ G. _____

C. _____ H. _____

D. _____ I. _____

E. _____ J. _____

4. A(n) _____ entry system uses an input keyboard to send electrical data to a small processor or computer.

POWER SEATS

5. Name the five major parts of a power seat system and describe them.

_____

_____

_____

_____

_____

_____

_____

_____

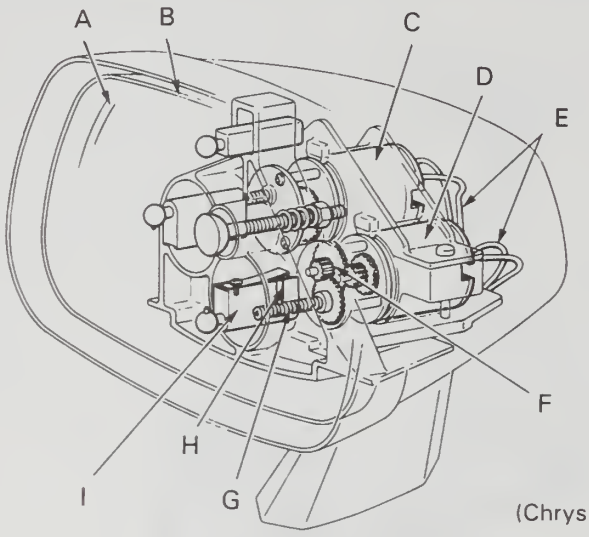
_____

_____

Name _____

POWER MIRRORS

6. Identify the parts indicated on the power rear view mirror shown below.

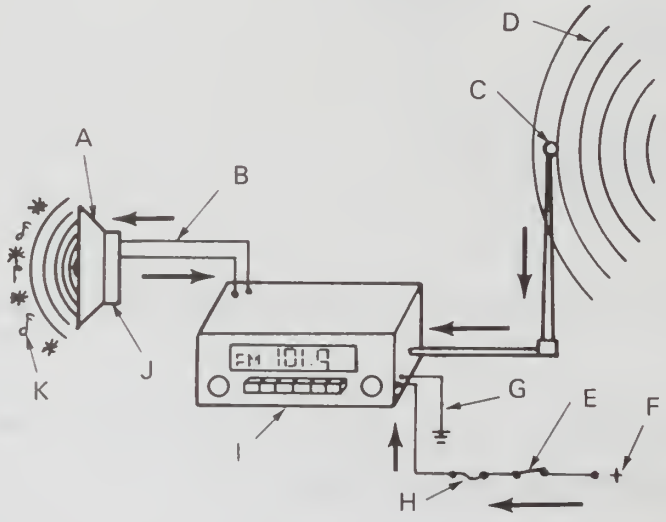


(Chrysler)

A. _____
B. _____
C. _____
D. _____
E. _____
F. _____
G. _____
H. _____
I. _____

SOUND SYSTEMS

7. Identify the parts indicated on the diagram of the radio system shown below.



A. _____
B. _____
C. _____
D. _____
E. _____
F. _____
G. _____
H. _____
I. _____
J. _____
K. _____

8. Which type of antenna picks up both AM and FM signals?
   a. Mast antenna.
   b. Antenna in glass.
   c. Both a and b.
   d. None of the above.
9. A(n) _____ _____ is simply an electronic amplifier that increases the current output of the radio or tape player for driving the speakers more efficiently.
10. True or false? The electronic circuitry in the compact disc player changes the digital data into analog outputs for driving the stereo speakers.

Chapter 20

OTHER ELECTRONIC SYSTEMS

Name _____

Date _____ Period _____

Instructor _____

OBJECTIVE: After studying this chapter, you will be able to describe other electronic systems often found in cars.

INSTRUCTIONS: As you study the text, complete the workbook problems.

ANTI-LOCK BRAKE SYSTEM (ABS)

1. Give two reasons the anti-lock brake system improves driver and passenger safety.

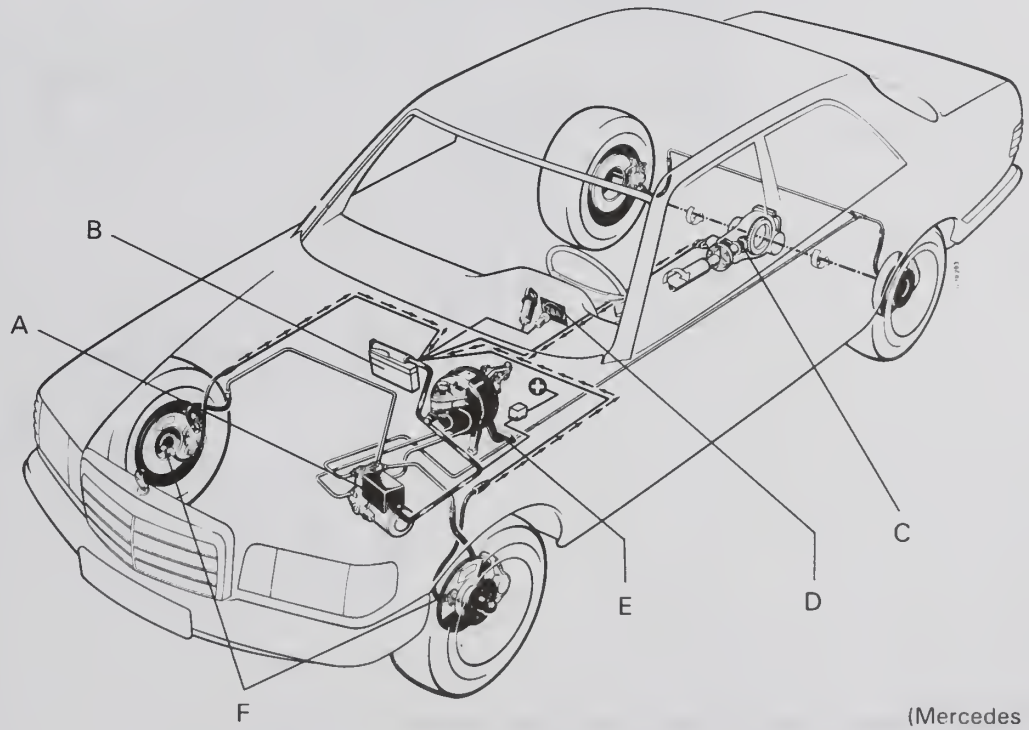
_____

_____

_____

_____

2. Identify the parts indicated in the diagram below.



(Mercedes Benz)

A. _____ D. _____

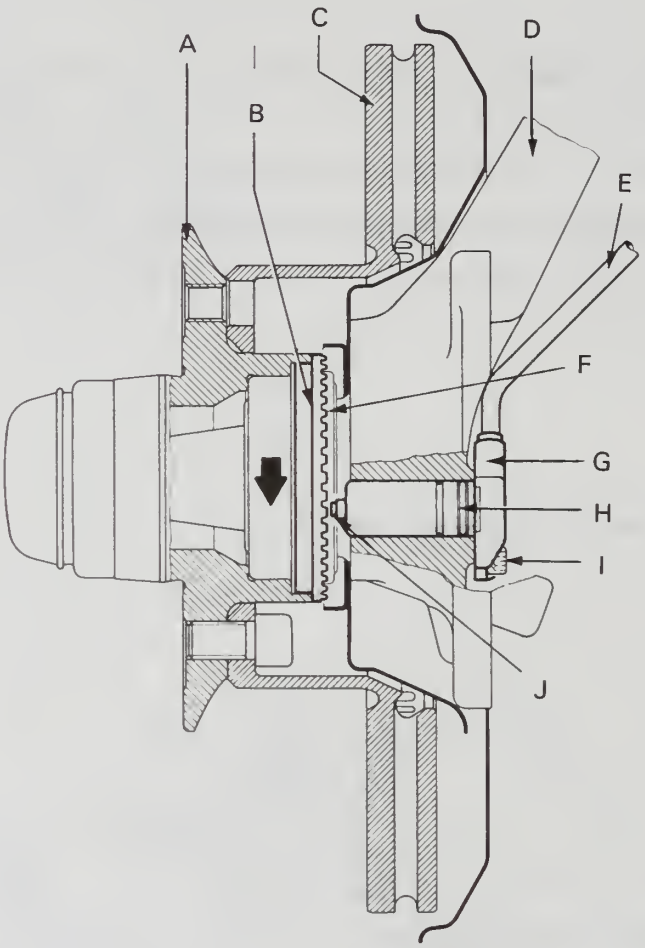
B. _____ E. _____

C. _____ F. _____

Name _____

ANTI-LOCK BRAKE SYSTEM (ABS) (Continued)

3. Identify the parts indicated on the diagram of the wheel speed sensor below.



(Mercedes Benz)

A. _____ F. _____

B. _____ G. _____

C. _____ H. _____

D. _____ I. _____

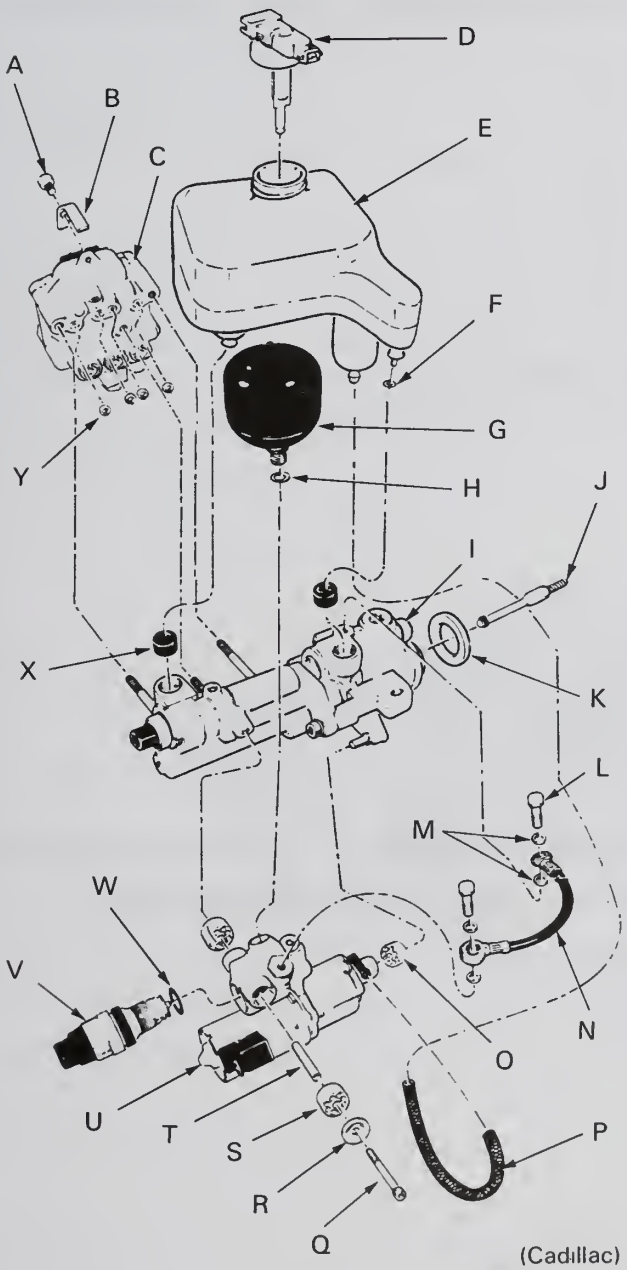
E. _____ J. _____

4. True or false? Under normal braking, the ABS system is used.

Name _____

ANTI-LOCK BRAKE SYSTEM (ABS) (Continued)

5. Identify the parts of the hydraulic actuator shown in the diagram below.



(Cadillac)

A. _____
B. _____
C. _____
D. _____
E. _____
F. _____
G. _____
H. _____
I. _____
J. _____
K. _____
L. _____
M. _____
N. _____
O. _____
P. _____
Q. _____
R. _____
S. _____
T. _____
U. _____
V. _____
W. _____
X. _____
Y. _____

ELECTRONIC HEIGHT CONTROL

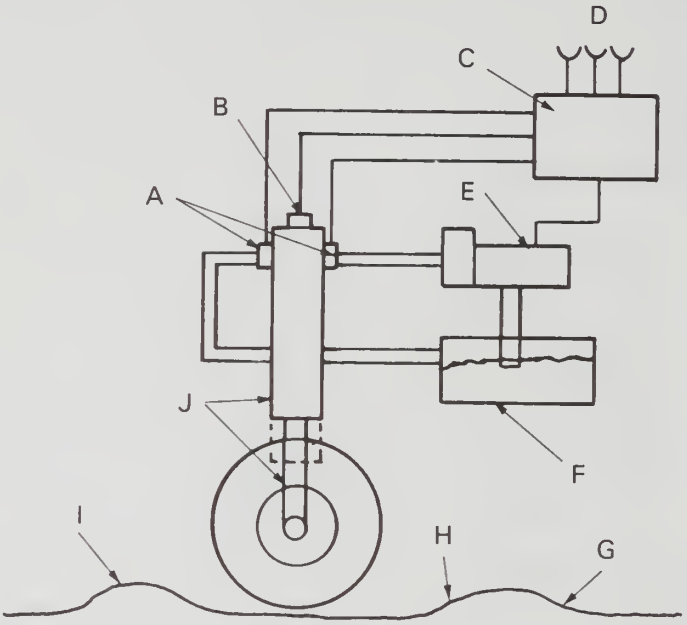
6. True or false? The electronic height system is used on the rear of the car to compensate for loads placed in the trunk or when passengers fill the back seat.

Name _____

ELECTRONIC SHOCK ABSORBER SYSTEM

7. In the electronic shock absorber system, the _____ can energize shock actuators to control ride stiffness and shock action.
8. Identify the parts indicated on the diagram of the active suspension system shown below. Use arrows to indicate fluid flow.

ACTIVE SUSPENSION



A. _____
B. _____
C. _____
D. _____
E. _____
F. _____
G. _____
H. _____
I. _____
J. _____

ELECTRONIC CLIMATE CONTROL

9. Name the six basic parts of an electronic climate control system and describe them.

_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____

Name _____

ELECTRONIC CRUISE CONTROL SYSTEM

10. Name the eight basic parts of an electronic cruise control system and describe them.

_____

_____

_____

_____

_____

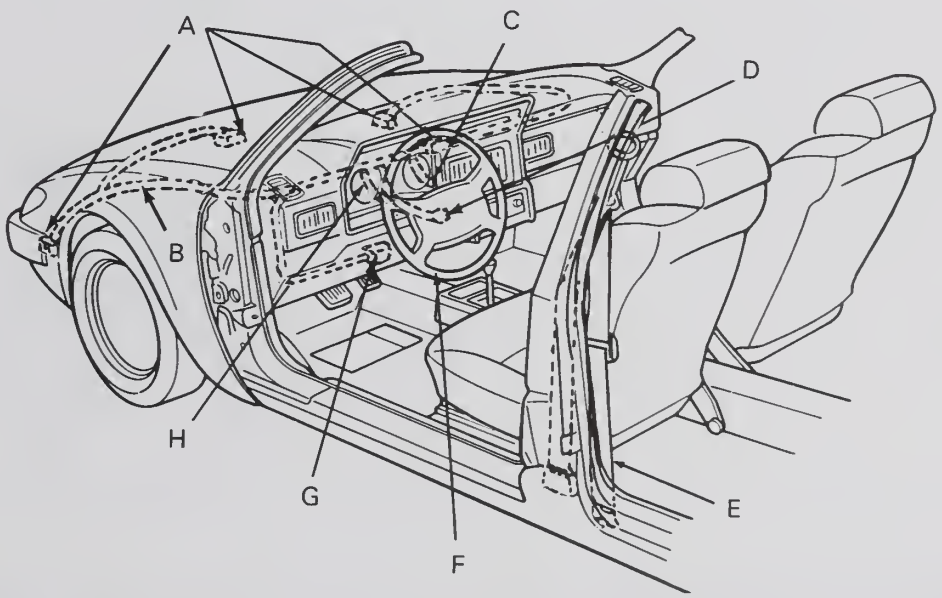
_____

_____

_____

ELECTRONIC AIRBAG SYSTEM

11. Identify the various parts indicated on the diagram of the electronic airbag system shown here.



(Ford)

A. _____ E. _____

B. _____ F. _____

C. _____ G. _____

D. _____ H. _____

ELECTRONIC TRANSMISSION/TRANSAXLE CONTROL

12. True or false? The electronic transmission/transaxle control system provides more accurate shift points and converter lockup for decreasing fuel economy.

ELECTRONIC FOUR-WHEEL STEERING SYSTEMS

13. Electronic four-wheel steering systems contain:
    a. an electronic control unit.
    b. steering angle sensors.
    c. motor-driven gearsets.
    d. All of the above.
14. True or false? An electronic failure in an electronic four-wheel steering system will cause a total loss of directional control.

Chapter 21

COMPUTER SELF-DIAGNOSIS, SCANNERS, ANALYZERS

Name _____

Date _____ Period _____

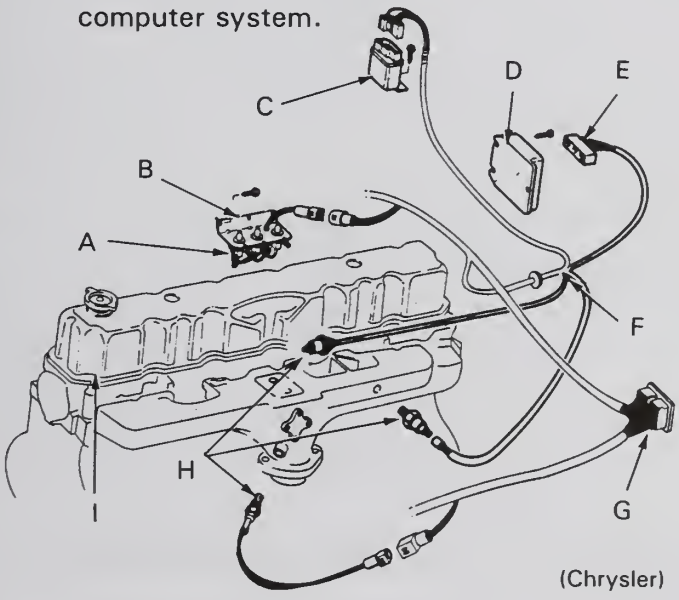
Instructor _____

OBJECTIVE: After studying this chapter, you will be able to describe computer self-diagnosis and the operation of scanners and analyzers.

INSTRUCTIONS: As you study the text, complete the workbook problems.

COMPUTER SELF-DIAGNOSIS (SELF-TEST)

1. On the diagram below, identify common problems that can affect vehicle performance and the computer system.



(Chrysler)

A. _____

B. _____

C. _____

D. _____

E. _____

F. _____

G. _____

H. _____

I. _____

2. As a general rule, about what percentage of all performance problems are caused by the computer and its sensors?
   a. 5 percent.
   b. 25 percent.
   c. 65 percent.
   d. 95 percent.
3. _____ _____ _____ are pulsing signals (number codes) produced by the computer when an operating parameter is exceeded.
4. The _____ _____, also called the assembly line diagnostic link (ALDL) or self-test connector, is a multipin terminal for triggering and reading computer trouble codes.

Name _____

COMPUTER SELF-DIAGNOSIS (SELF-TEST) (Continued)

5. Diagnostic connector locations vary. Where would you expect to locate the diagnostic connection on each of the following cars?
   A. Ford: _____
   B. General Motors: _____
   C. Chrysler: _____
6. Name eight common methods used to activate or energize computer self-diagnosis to pull out trouble codes.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

7. True or false? Connecting a jumper wire or voltmeter to the wrong terminal on a diagnostic connector could ruin delicate electronic components.
8. When performing the engine off/key on self-test, what may be the cause of false trouble codes?

_____

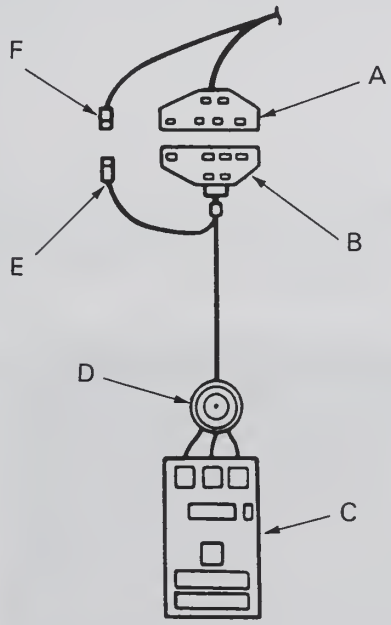
9. True or false? Engine running self-diagnosis is done on a cold engine to check the sensor valves.
10. True or false? A hard failure is a computer term meaning an intermittent problem that only happens under some conditions.
11. If, after entering the diagnosis mode, the engine light flashes twice, pauses, and flashes three more times, what would the trouble code be? _____

_____

Name _____

COMPUTER SELF-DIAGNOSIS (SELF-TEST) (Continued)

12. Which of the following is read by counting the number of needle deflections between each pause?
    a. Analog voltmeter code.
    b. Test light code.
    c. LED code.
    d. Digital code.
13. A(n) _____ is an electronic test instrument designed to convert computer pulses or signals directly into a digital or number display.
14. Identify the parts indicated in the diagram below.



(Ford)

A. _____
B. _____
C. _____
D. _____
E. _____
F. _____

15. True or false? A general rule is to correct the cause of the lowest number code first because fixing the lowest code will sometimes clear other codes because of component interaction.
16. Fast codes are read with:
    a. A dash light.
    b. An analog meter.
    c. A scanner.
    d. None of the above.
17. True or false? Pinpoint tests are completed before doing the self-diagnosis tests.
18. Why should a low impedance (resistance) analog meter or test light NEVER be connected to a computer system unless instructed to do so by the service manual? _____

_____

_____

_____

Name _____

COMPUTER SELF-DIAGNOSIS (SELF-TEST) (Continued)

19. List six ways to erase trouble codes from computer memory.

_____

_____

_____

_____

_____

_____

COMPUTER ANALYZERS

20. A computer analyzer can:
    a. Read trouble codes.
    b. Show actual electrical values.
    c. Sometimes manipulate (energize) components.
    d. All of the above.
21. A(n) _____ _____ system allows a shop-owned analyzer to communicate over telephone lines with a larger mainframe computer.

ENGINE ANALYZER AND OSCILLOSCOPE

22. List 12 pieces of test equipment that might be included on an engine analyzer.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

23. An _____ is a cathode ray tube that displays a line pattern representing voltages in relation to time.

Name _____

ENGINE ANALYZER AND OSCILLOSCOPE (Continued)

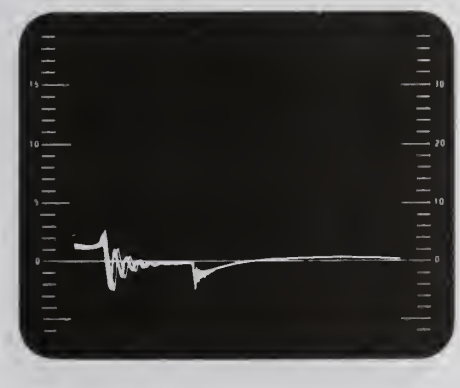
24. Match the following terms to their descriptions.

_____ 1. Primary pattern.
_____ 2. Secondary scope pattern.
_____ 3. Firing line.
_____ 4. Spark line.
_____ 5. Coil oscillations.
_____ 6. Dwell section.

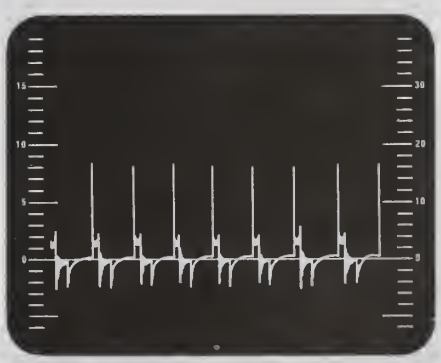
a. Shows the voltage needed to maintain an arc or spark across the spark plug electrodes.
b. Shows the low voltage or primary voltage changes in an ignition system.
c. Shows the voltage fluctuations after the spark plug stops firing.
d. Shows the actual high voltages needed to fire the spark plugs.
e. Starts when the points close and ends when the points open.
f. The tall spark or line representing the amount of voltage needed to make the electric arc first jump across the spark plug gap.

SCOPE TEST PATTERNS

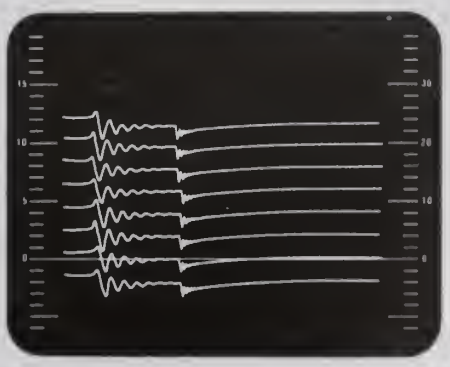
25. Identify each of the frequently used scope test patterns shown below.



A. _____



B. _____

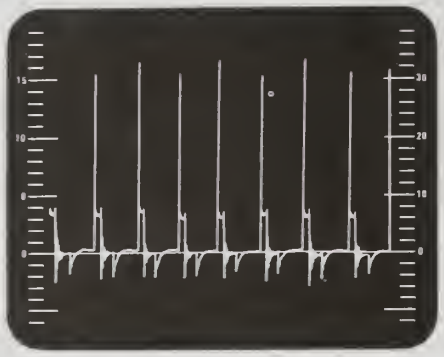


C. _____

Name _____

SCOPE TEST PATTERNS (Continued)

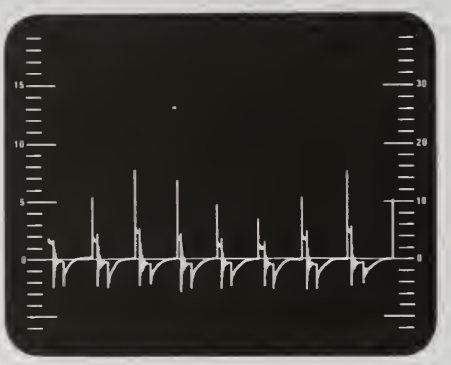
26. Identify the various problems shown on the scope screens below and explain how each problem is caused.



A. _____

_____

_____



B. _____

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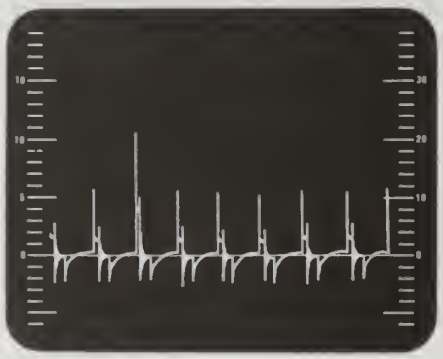

C. _____

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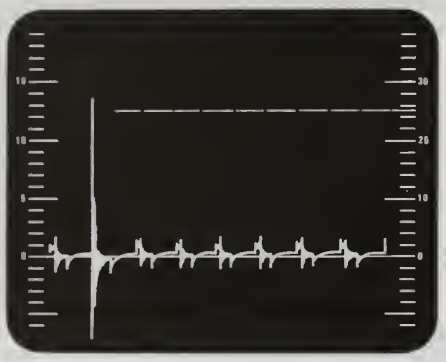


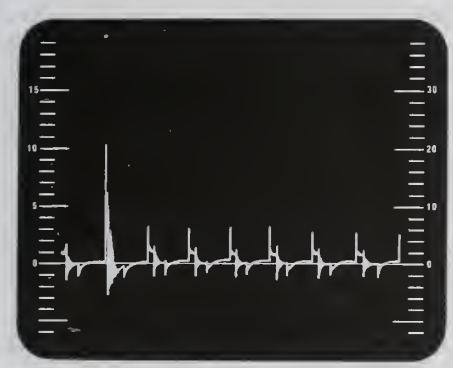
D. _____

_____

_____

Name _____

SCOPE TEST PATTERNS (Continued)



E. _____

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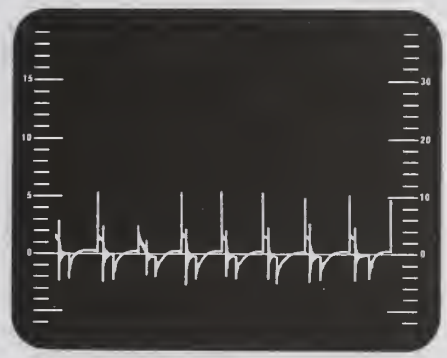

F. _____

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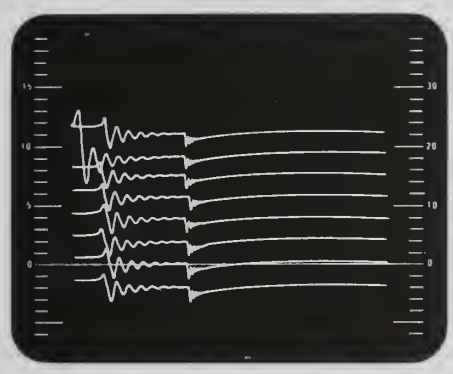
_____



G. _____

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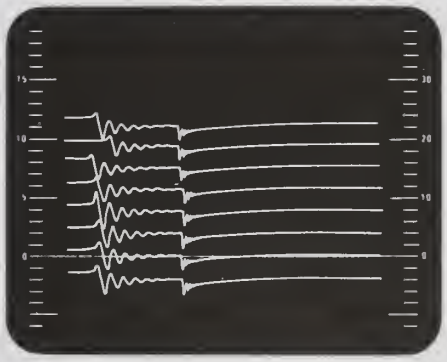

H. _____

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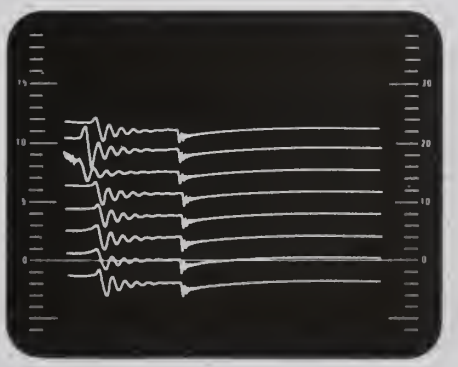
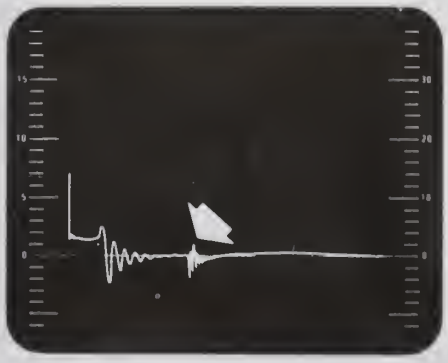


I. _____

_____

_____



J. _____

_____

_____

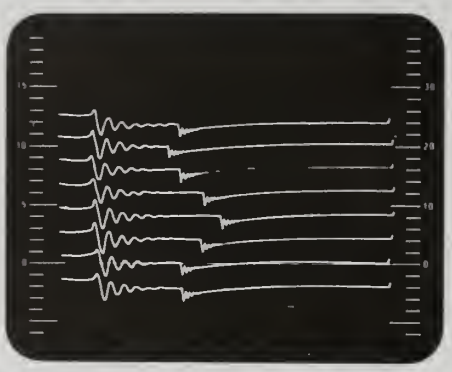
Name _____

SCOPE TEST PATTERNS (Continued)

K. _____

_____

_____



L. _____

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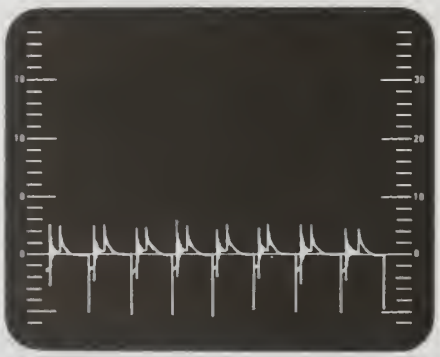
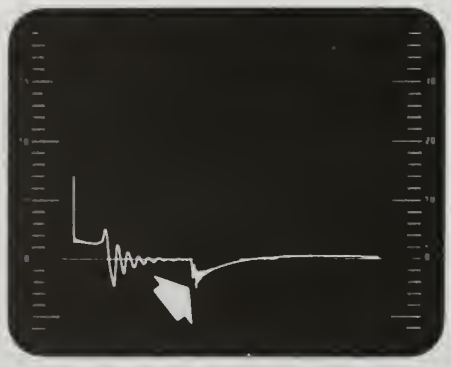


M. _____

_____

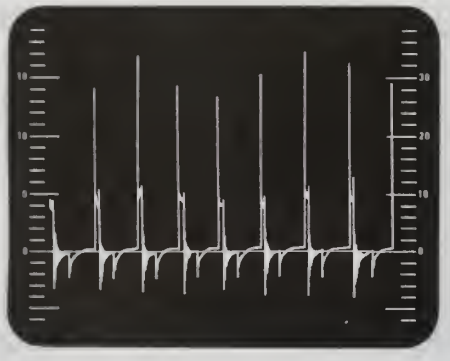
_____



N. _____

_____

_____



(FMC)

O. _____

_____

_____

Name _____

EXHAUST GAS ANALYZERS

27. Name 10 types of information that an exhaust gas analyzer will indicate.

28. True or false? The four-gas exhaust analyzer measures hydrocarbons, carbon monoxide, carbon dioxide, and oxygen in an engine's exhaust.

29. Name five conditions that could cause a higher-than-normal HC reading.

30. List four typical causes for high CO readings.

31. True or false? Typically O_2 readings should be about 8 percent.

32. Why should you never let engine exhaust fumes escape into an enclosed shop area when using an exhaust analyzer, and what can you do to trap and remove the toxic fumes? _____

Name _____

ENERGIZING SELF-DIAGNOSIS (TROUBLE CODES)

33. List the six typical steps used to make an on-board computer produce trouble codes on a General Motors Corporation car.

34. List the six typical steps used to make an on-board computer produce trouble codes on a Ford Motor Company car.

35. List the five typical steps used to make an on-board computer produce trouble codes on a Chrysler Corporation car.

Chapter 22

SENSOR, ACTUATOR, COMPUTER SERVICE

Name _____

Date _____ Period _____

Instructor _____

OBJECTIVE: After studying this chapter, you will be able to describe how to perform sensor, actuator, and computer service.

INSTRUCTIONS: As you study the text, complete the workbook problems.

PRELIMINARY INSPECTION

1. What is the cipet principle and what does the term ''cipet'' represent? _____

_____

_____

C: _____

I: _____

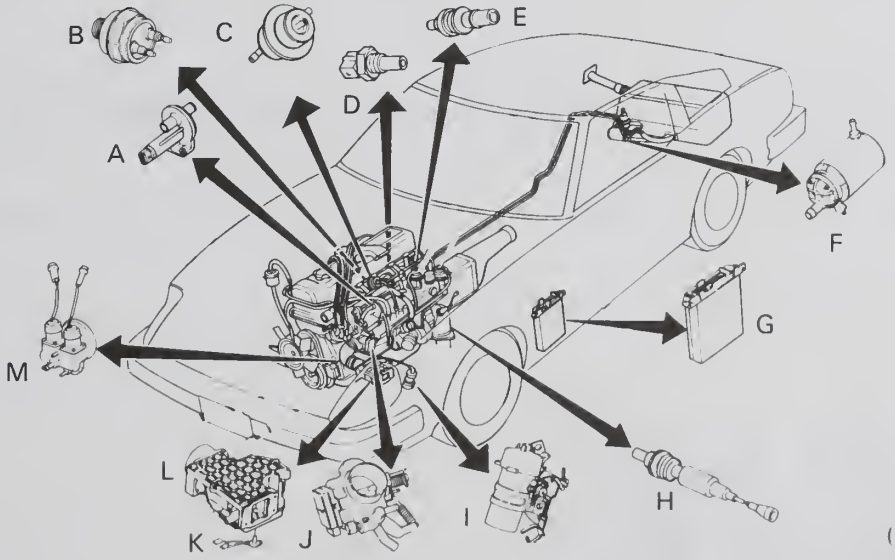
P: _____

E: _____

T: _____

SENSOR SERVICE

2. Identify the sensors and actuators indicated on the diagram below.



(Nissan)

A. _____

B. _____

C. _____

D. _____

E. _____

F. _____

G. _____

H. _____

I. _____

J. _____

K. _____

L. _____

M. _____

Name _____

SENSOR SERVICE (Continued)

3. True or false? Poor electrical connections are the most common cause of electrical related problems in a computer system.
4. _____ leaks can cause a wide range of problems, many of which can appear to be computer related.

SENSOR PROBLEMS, TESTING, REPLACEMENT

5. Which of the following sensors requires a digital meter for testing?
   a. Ohmmeter.
   b. Voltmeter.
   c. Voltage generating sensor.
   d. None of the above.
6. A reference voltage of typically _____ volts is fed to switching and variable resistance type sensors.
7. A bad engine speed sensor will sometimes keep an engine from running by disabling the _____ system.
8. True or false? A bad vehicle speed sensor will usually reduce engine performance and fuel economy, but will not normally keep the engine from running.
9. Name three causes of oxygen sensor contamination.

   _____

   _____

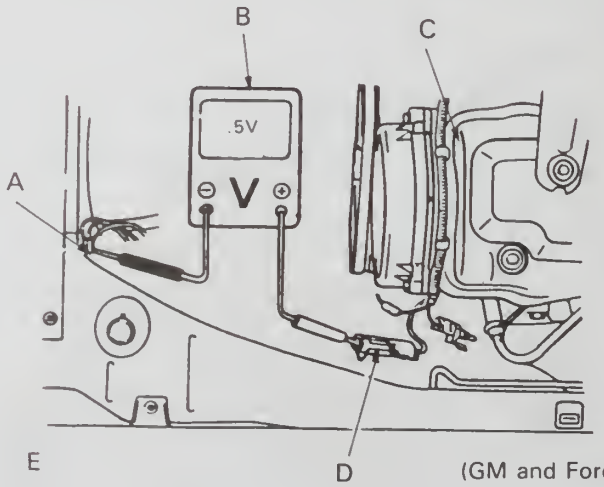
   _____

10. Explain why you should not use a conventional analog or low resistance meter to measure oxygen sensor voltage.

    _____

    _____

11. Identify the parts indicated on the diagram below.



(GM and Ford)

A. _____
B. _____
C. _____
D. _____
E. _____

Name _____

SENSOR PROBLEMS, TESTING, REPLACEMENT (Continued)

12. List 10 rules to follow when replacing an oxygen sensor.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

13. When reading an oxygen sensor, which tip color is a normal color for an oxygen sensor?
    a. Light gray.
    b. White.
    c. Tan.
    d. Black.
14. Describe how to test a manifold pressure sensor.

_____

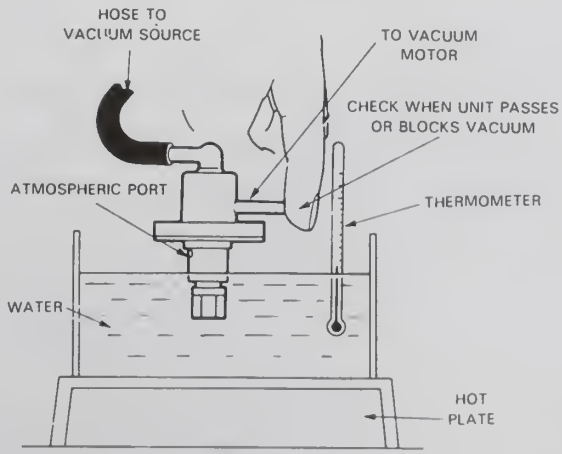
_____

_____

15. A(n) _____ _____ sensor signals the computer when the gas pedal is depressed to different positions for acceleration, deceleration, idle, cruise, and full power.
16. A(n) _____ is commonly recommended to test the idle switch.
17. True or false? The coolant sensor richens the air-fuel ratio when cold and leans the mixture when hot.
18. Describe what is happening in the diagram below. _____

_____

_____



(General Motors)

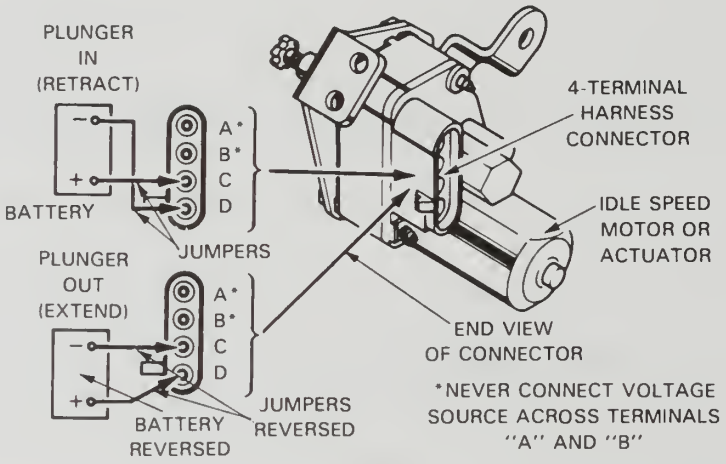
Name _____

SENSOR PROBLEMS, TESTING, REPLACEMENT (Continued)

19. Explain why you should make sure the fuel tank is almost empty before removing the fuel sending unit. _____

ACTUATOR SERVICE

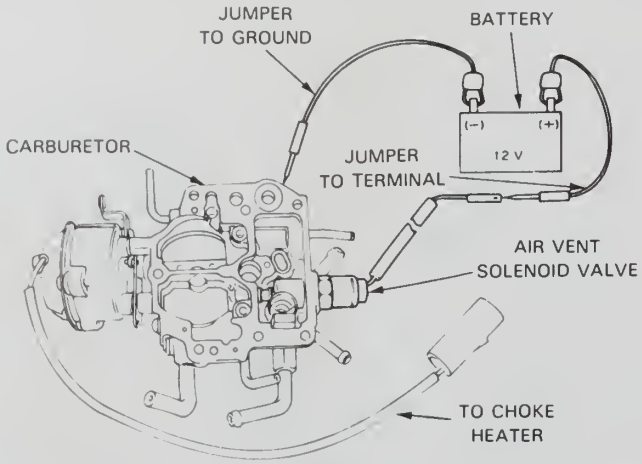
20. Describe what is happening in the diagram below. _____



(GM)

21. Describe how to check the idle air control valve. _____

22. What is happening in the diagram below? _____

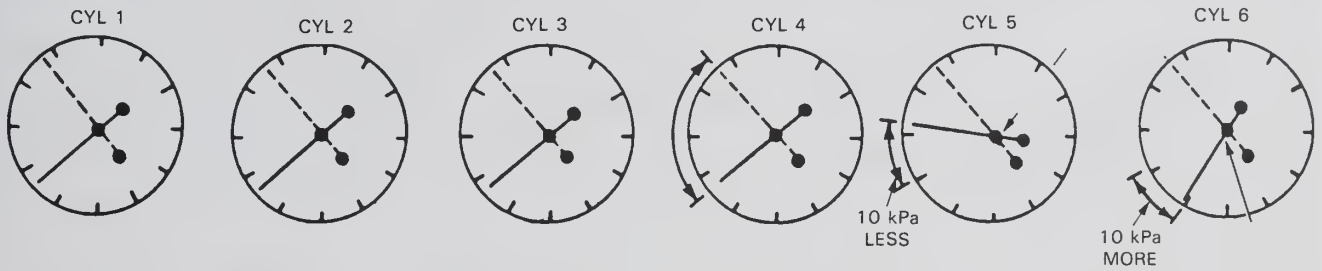


(GM)

Name _____

ACTUATOR SERVICE (Continued)

23. True or false? During testing of the mixture control solenoid, when voltage is applied, the unit should release or pass vacuum.
24. Using a _____ is a quick and easy way to see if fuel injectors are opening and closing.
25. Look at the diagrams below. Indicate whether each is a good injector, clogged injector, or a sticking/leaking injector.



A. _____ B. _____ C. _____ D. _____ E. _____ F. _____

26. To test an electric fuel pump, you can:
    a. Measure motor resistance with an ohmmeter and compare it to specs.
    b. Jump battery voltage to make sure the motor starts running.
    c. Use a voltmeter to check how much voltage is being fed to the electric fuel pump.
    d. All of the above.

COMPUTER SERVICE

27. True or false? Only after all other potential sources of troubles have been eliminated, is the computer suspected of being the source of car problems.
28. A small, inexpensive _____ _____ can be used to find induced or radiated voltage sources.
29. Explain how to correct a radiation problem affecting a computer._____

    _____

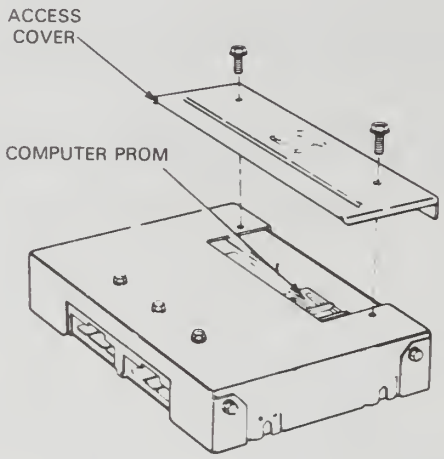
    _____
30. True or false? One wrong electrical connection can "fry" delicate electronic components.
31. Saving memory can be done by connecting small batteries across the two battery cables _____ (after, before) the car battery is disconnected.
32. Explain why the ignition key should be off and the car battery disconnected when removing a computer. _____

    _____

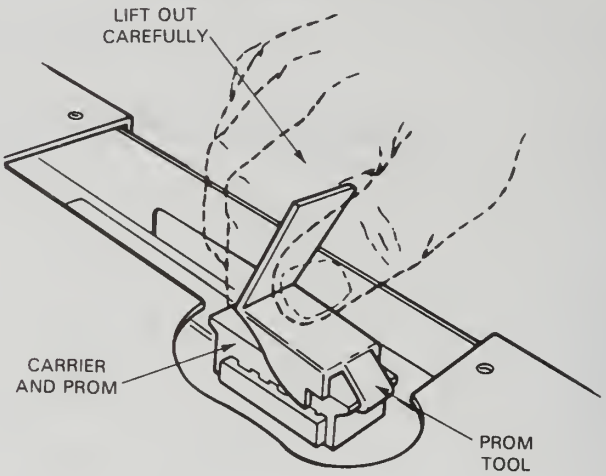
Name _____

COMPUTER SERVICE (Continued)

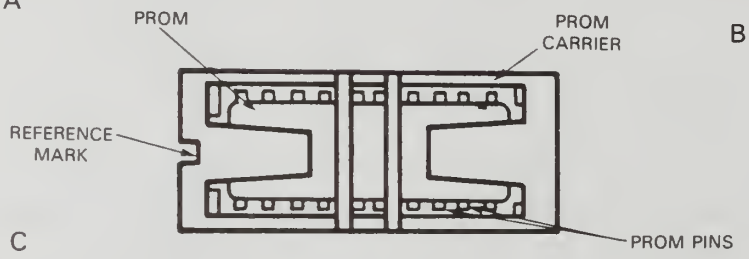
33. Describe what is being done in each of the diagrams below.



A



B



C

A. _____

_____

B. _____

_____

C. _____

_____

34. If you install a prom backwards, it:
    a. Will usually require replacement because of damage.
    b. Will have no effect.
    c. Will cause serious damage to the computer.
    d. None of the above.
35. Aftermarket proms:
    a. Richen the fuel mixture.
    b. Advance ignition timing.
    c. Increase exhaust emissions.
    d. All of the above.
36. True or false? Flash memory eliminates the need to change the PROM when the computer program must be updated.

Chapter 23

BATTERY AND STARTING SYSTEM SERVICE

Name _____

Date _____ Period _____

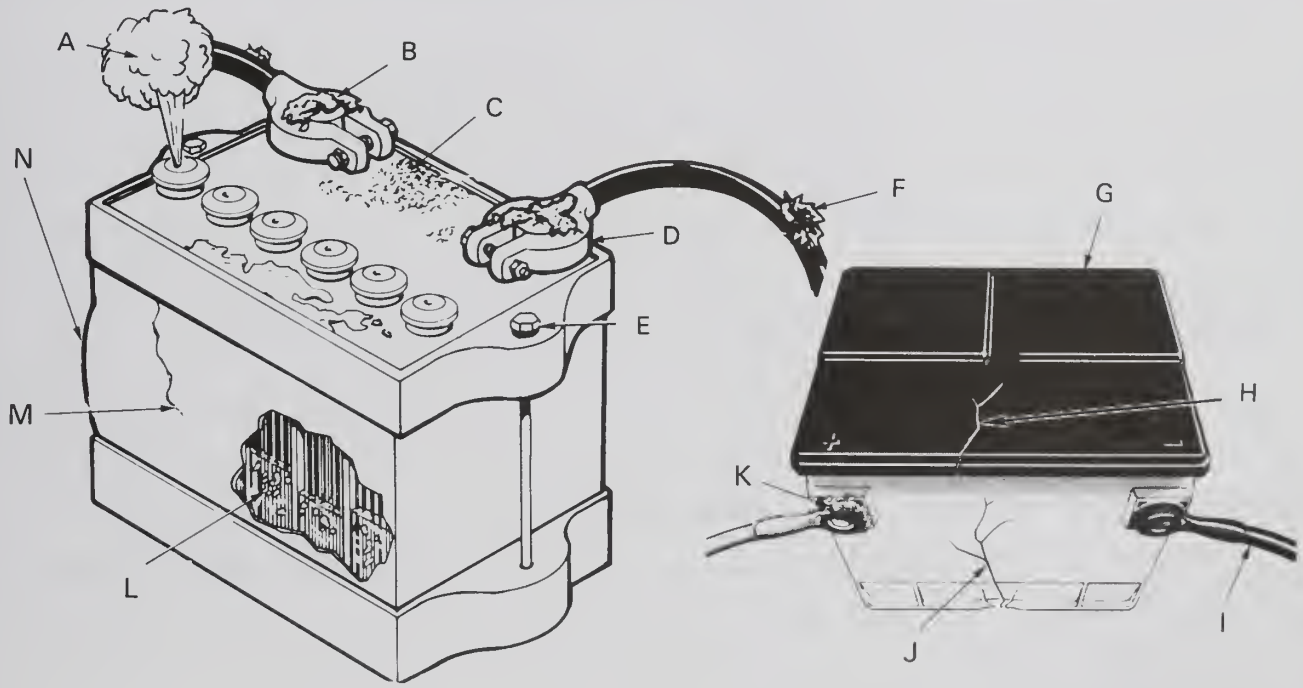
Instructor _____

OBJECTIVE: After studying this chapter, you will be able to describe how to perform battery and starting system service.

INSTRUCTIONS: As you study the text, complete the workbook problems.

BATTERY SERVICE

1. Identify various battery troubles that can cause a discharged or "dead" battery.



(Florida Dept. of Voc. Ed. and Sun Electric)

A. _____

B. _____

C. _____

D. _____

E. _____

F. _____

G. _____

H. _____

I. _____

J. _____

K. _____

L. _____

M. _____

N. _____

Name _____

BATTERY SERVICE (Continued)

2. List five things you should check for when inspecting a battery.

_____

_____

_____

_____

_____

3. A battery _____ test is done to determine if current is discharging across the top of a dirty battery case.
4. A battery _____ test is used to check for a poor electrical connection between the battery cables and terminals.

BATTERY MAINTENANCE

5. List five battery maintenance steps.

_____

_____

_____

_____

_____

6. Why is it necessary to wear eye protection when working around batteries? _____

_____

_____

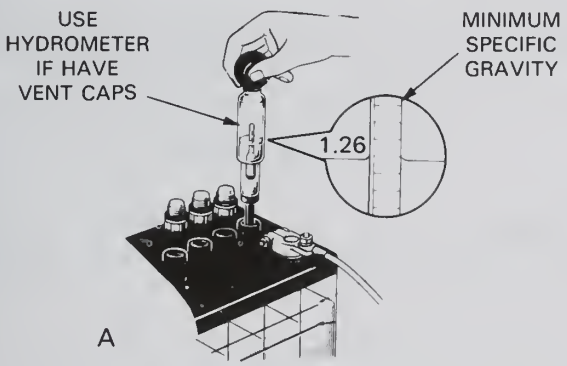
_____

7. If the top of the battery is dirty, wash it down with:
   a. Baking soda and water.
   b. Vinegar.
   c. Soap and water.
   d. Either a or c.
8. True or false? Under normal conditions, a maintenance-free battery needs periodic electrolyte service.

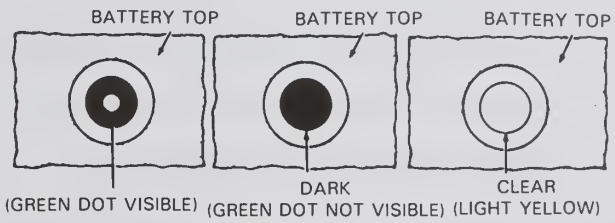
Name _____

CHECKING BATTERY CHARGE

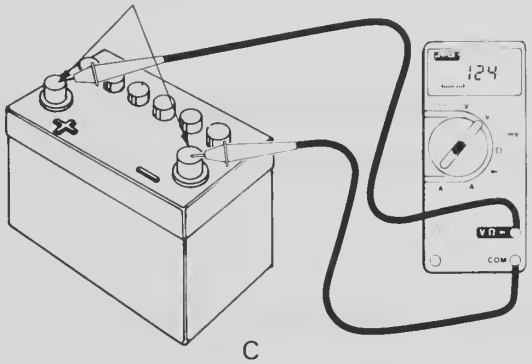
9. Identify the various methods of checking the state of battery charge below.



A



B



C

(Toyota, GM, and Fluke)

A. _____

B. _____

C. _____

10. Name six causes of a discharged battery.

_____

_____

_____

_____

_____

_____

Name _____

BATTERY VOLTAGE TEST

11. A well charged battery should have over _____ volts.
12. A _____ voltage test will let you know if the battery is defective or just discharged.

JUMP STARTING

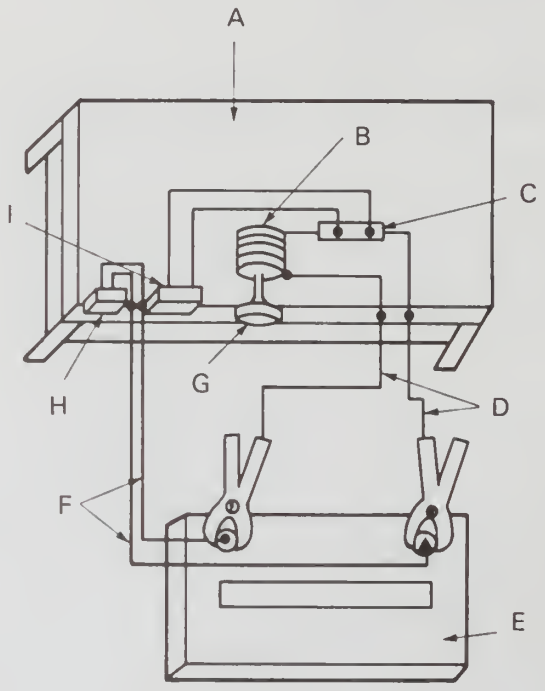
13. When jump starting a battery, two batteries are connected positive to _____ (negative, positive) and negative to _____ (negative to positive).

BATTERY CHARGERS

14. True or false? The battery charger will force current back into the battery to restore the charge on the battery plates and in the electrolyte.
15. True or false? A trickle charger forces high current flow into the battery for rapid recharging.
16. Before connecting a battery charger to a battery, make sure the charger is turned _____ (off, on).

BATTERY LOAD TEST

17. Identify the parts indicated on the diagram of the load tester below.



A. _____
B. _____
C. _____
D. _____
E. _____
F. _____
G. _____
H. _____
I. _____

18. True or false? If a load tester is not inductive, you must connect the ammeter in series.
19. Before a load test, make sure the battery is adequately _____ (charged, discharged).

Name _____

BATTERY LOAD TEST (Continued)

20. A battery with 500 cold cranking amps should be loaded to:
    a. 100 amps.
    b. 250 amps.
    c. 500 amps.
    d. 1000 amps.
21. If the voltmeter reads _____ volts or more at room temperature, the battery power is acceptable.
22. A quick (3-minute) charge test is used to determine if the battery is _____.

OTHER BATTERY-RELATED PROBLEMS

23. If the battery passes all of its tests, but the battery does not perform properly, name five other problems you should check.

_____

_____

_____

_____

_____

REMOVING AND REPLACING A BATTERY

24. True or false? A replacement battery should have a power rating equal to factory recommendations.
25. A battery _____ test is used to check for an abnormal current draw with the ignition key off.

STARTING SYSTEM DIAGNOSIS

26. A buzzing or clicking sound from the solenoid without cranking is commonly due to:
    a. A bad starter.
    b. A discharged battery or poor battery cable connections.
    c. A broken or worn flywheel.
    d. None of the above.
27. When performing a starting headlight test, if the lights go out when cranking:
    a. The battery is dead.
    b. There may be high resistance in the starting circuit.
    c. The battery may be weak.
    d. None of the above.

Name _____

STARTER CURRENT DRAW TEST

28. What could happen if the engine were cranked for more than 15-30 seconds? _____

_____

STARTING SYSTEM VOLTAGE DROP TESTS

29. True or false? You must disconnect wires and components to check internal resistances (voltage drops).
30. A(n) _____ _____ _____ test is used to check all parts between the battery positive and the starting motor for excess resistance.
31. A(n) _____ _____ _____ test is done to check the circuit between the starting motor ground and the negative battery terminal.

BATTERY CABLE PROBLEMS

32. How do you test the battery or starter cables? _____

_____

_____

33. Cables with _____ (lead, steel) terminals are better than those with _____ (lead, steel) ends.

STARTER SOLENOID SERVICE

34. A(n) _____ _____ test will quickly check the condition of solenoid and its electrical connections.

IGNITION SWITCH SERVICE

35. A faulty ignition switch can keep the starter solenoid from _____.
36. True or false? If the test light on the solenoid does not glow, either a wire in the ignition switch circuit is open or the ignition switch is defective.

STARTER RELAY SERVICE

37. To test a starter relay, use a test light or VOM to check for voltage going into and coming out of the _____ _____.

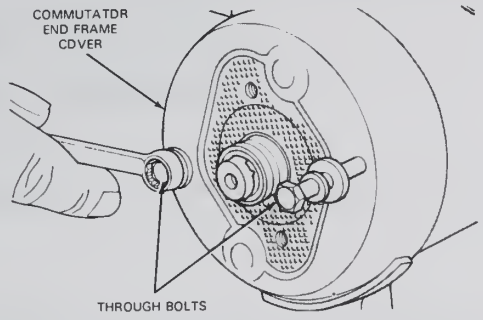
NEUTRAL SAFETY SWITCH SERVICE

38. True or false? If the neutral safety switch is open, current cannot flow from the ignition switch to the starter solenoid.

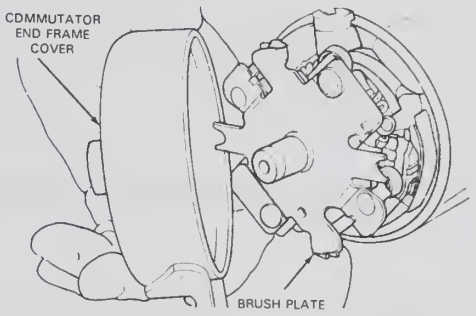
Name _____

STARTER SERVICE

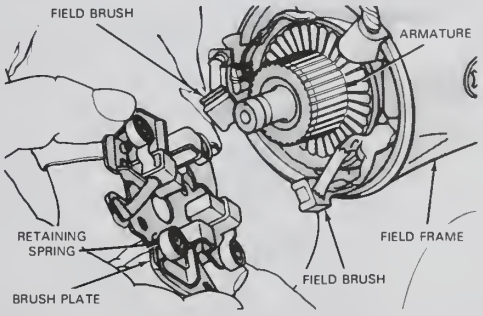
39. The basic steps involved in starter disassembly are illustrated below. Label them.



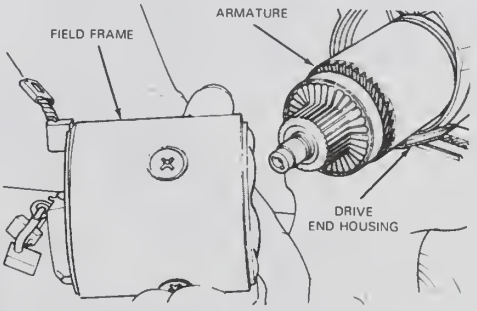
A. _____



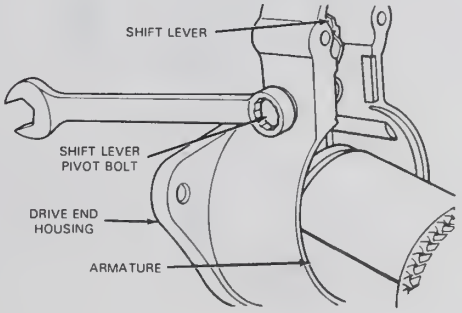
B. _____



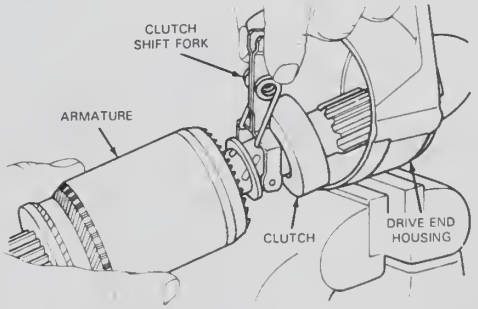
C. _____



D. _____



E. _____



F. _____

(Chrysler)

40. To check armature continuity, do a(n) _____ _____ test.
41. When the test light does not glow or the meter reads infinite resistance, the field windings are open and must be:
    a. Replaced.
    b. Repaired.
    c. Ignored.
    d. None of the above.
42. It is usually wise to replace the _____ gear during starter service.

Name _____

STARTER SERVICE (Continued)

43. Explain why it is important not to use too much oil or grease to lubricate the bushings and other parts of a starting motor.

_____

_____

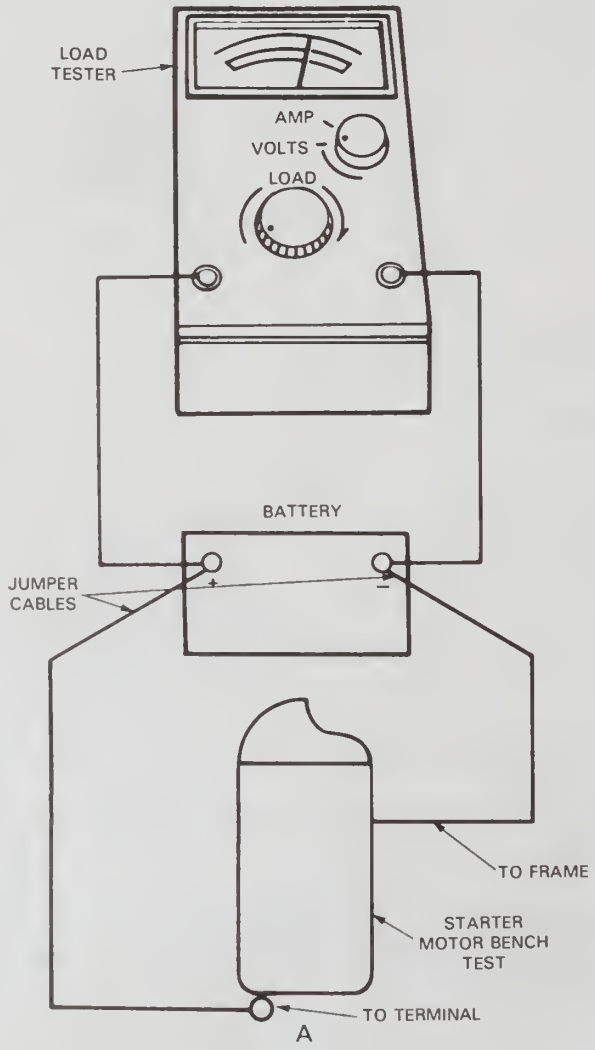
_____

44. Why is it necessary that any spacer shims are replaced between the motor and the engine block?

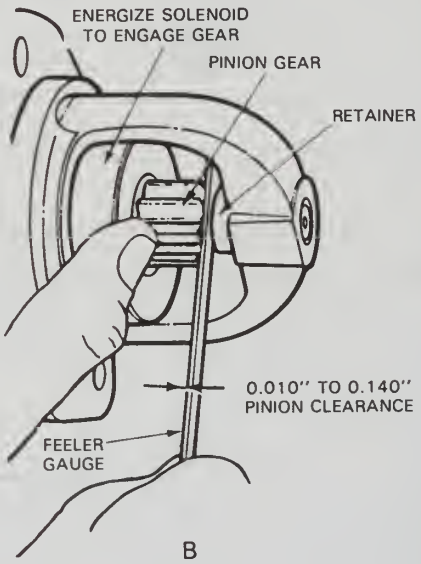
_____

_____

45. Describe what is being done in the diagrams of the installation of a starting motor after rebuilding.



A



B

(Ford and GM)

A. _____

_____

B. _____

_____

Chapter 24

CHARGING SYSTEM DIAGNOSIS AND REPAIR

Name _____

Date _____ Period _____

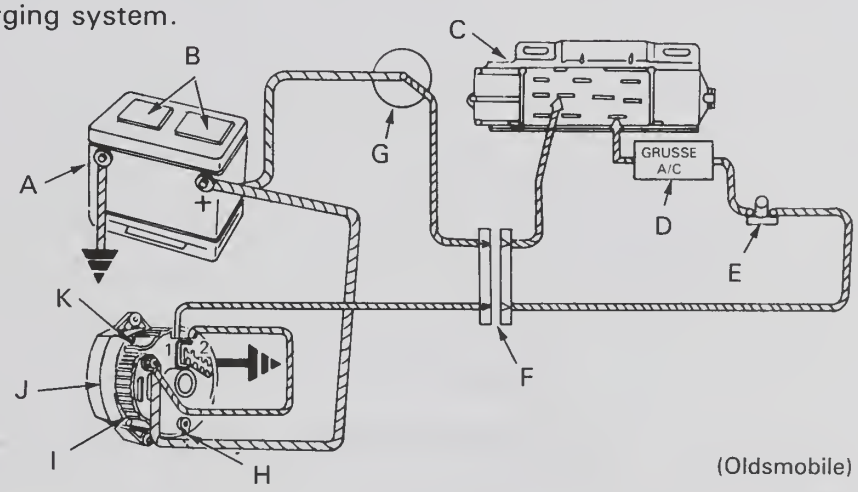
Instructor _____

OBJECTIVE: After studying this chapter, you will be able to describe how to diagnose and repair a charging system.

INSTRUCTIONS: As you study the text, complete the workbook problems.

CHARGING SYSTEM DIAGNOSIS

1. Look at the diagram below. Identify the problems that can affect or appear to affect the operation of a charging system.



(Oldsmobile)

A. _____

B. _____

C. _____

D. _____

E. _____

F. _____

G. _____

H. _____

I. _____

J. _____

K. _____

2. Name four types of symptoms caused by charging system problems.

_____

_____

_____

_____

3. Explain why an alternator belt should only be tightened enough to prevent belt slippage or flap.

_____

_____

Name _____

CHARGING SYSTEM PRECAUTIONS

4. List six precautions to follow when working on a charging system.

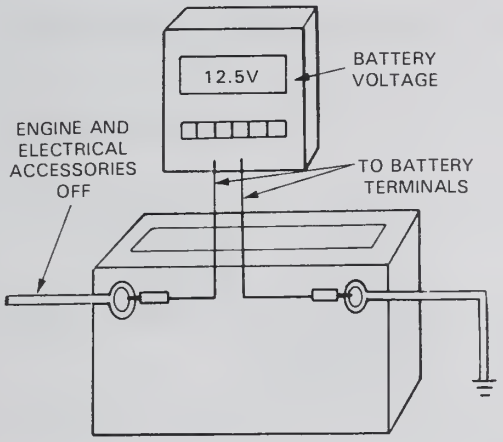
CHARGING SYSTEM TESTS

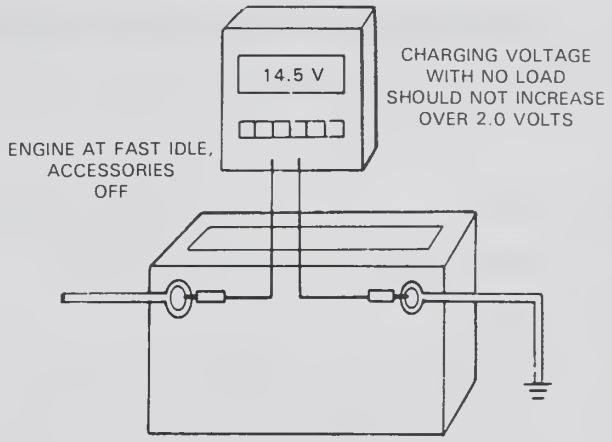
5. Name and describe four charging system tests.

Name _____

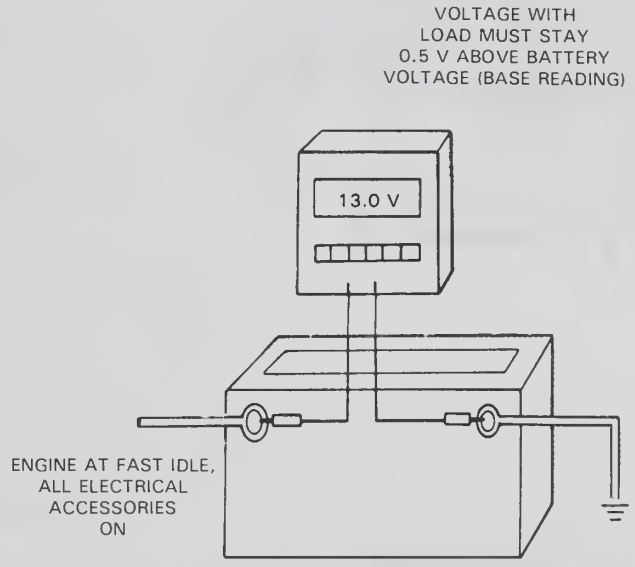
VOLTMETER TEST OF CHARGING OUTPUT

6. Identify the basic steps of using VOM to check the condition of a charging system.





A. _____ B. _____


VOLTAGE WITH LOAD MUST STAY 0.5 V ABOVE BATTERY VOLTAGE (BASE READING)
13.0 V
ENGINE AT FAST IDLE, ALL ELECTRICAL ACCESSORIES ON

C. _____

7. True or false? A voltmeter load test should be performed before a voltmeter no-load test.

Name _____

LOAD TESTER CHECK OF CHARGING SYSTEM

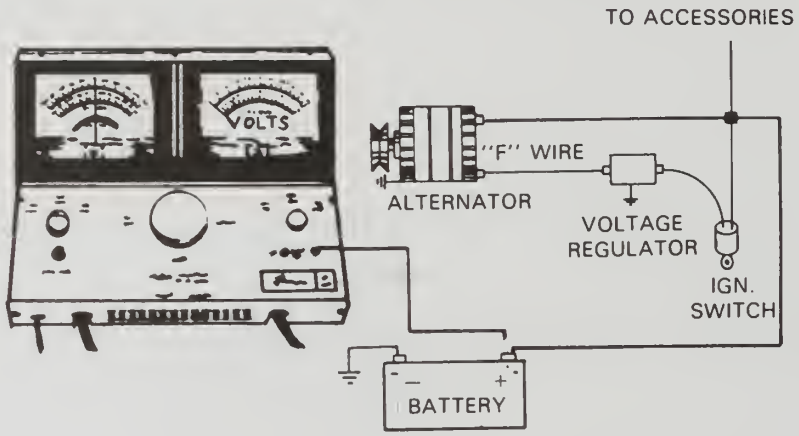
8. A charging system _____ test measures system current and voltage under maximum load.
9. Explain how to calculate charging system output. _____

_____

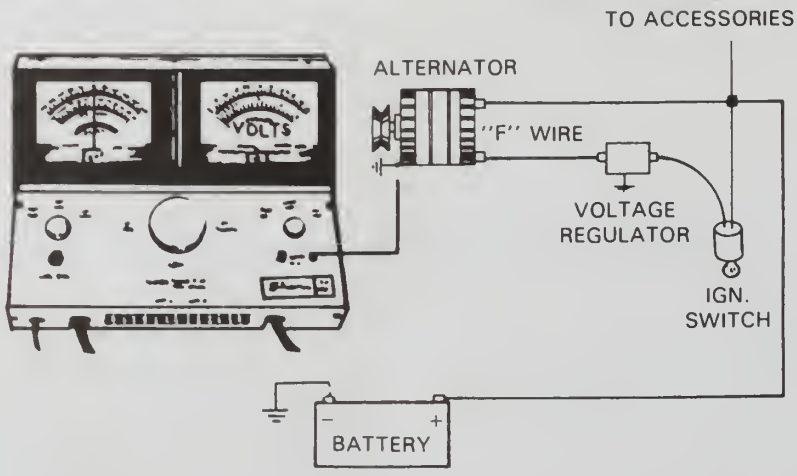
_____

_____

10. A(n) _____ voltage test will check the calibration of the voltage regulator and detect a high or low voltage setting.
11. A(n) _____ _____ test is a quick and easy way of finding out if the alternator, the regulator, or the circuit is faulty.
12. If charging voltage and current increase to normal levels when the regulator is bypassed, you usually have a _____ (bad, good) regulator.
13. Identify the voltage drop or resistance tests shown below.



A. _____



B. _____ (Snap-on Tools)

Name _____

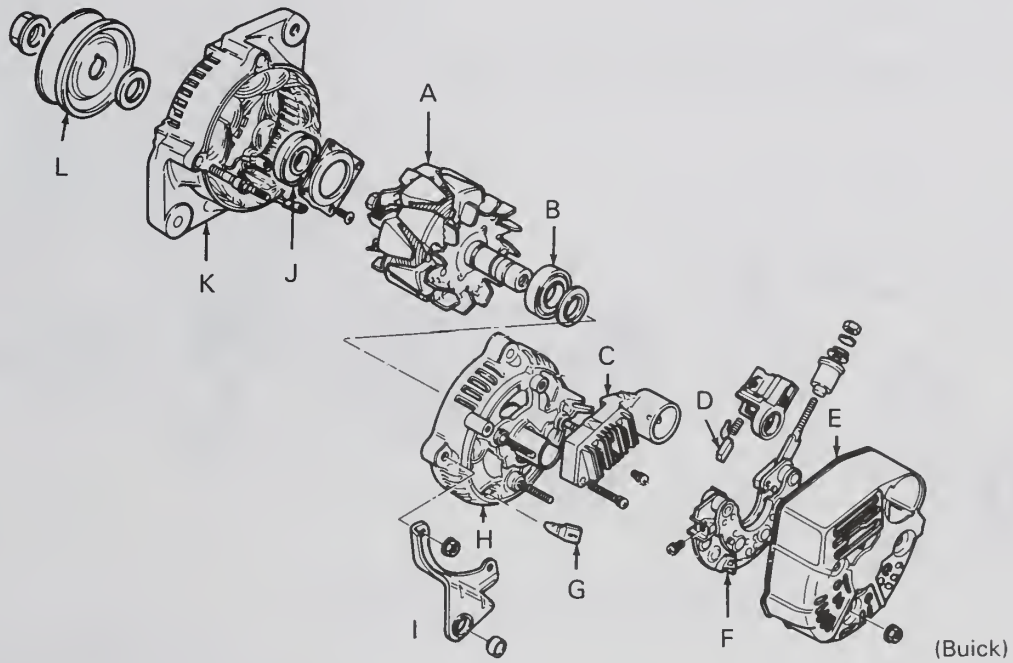
ALTERNATOR SERVICE

14. Before unbolting the alternator, disconnect the _____ to prevent damage to parts if wires are shorted.

15. When disassembling an alternator, why should you scribe marks on the outside of the housing?

_____

16. Identify the parts of the alternator below.



(Buick)

A. _____ G. _____

B. _____ H. _____

C. _____ I. _____

D. _____ J. _____

E. _____ K. _____

F. _____ L. _____

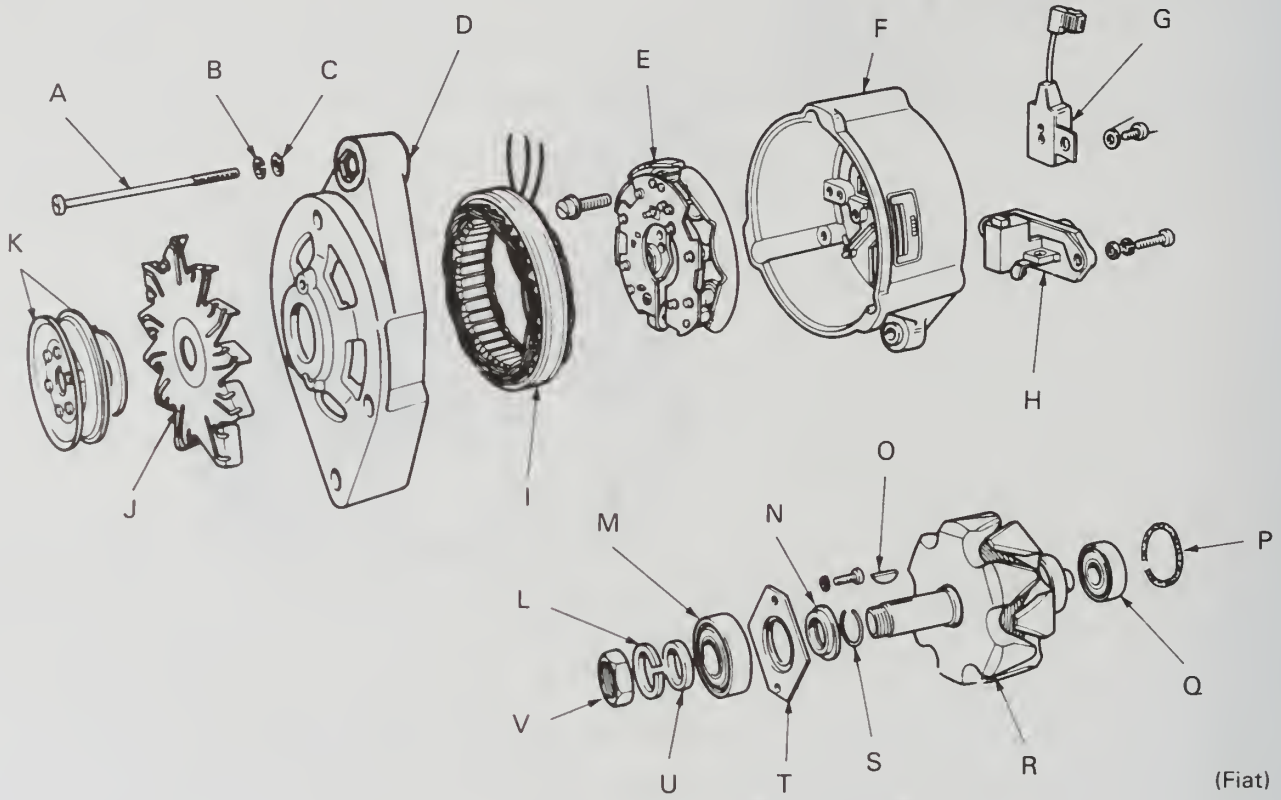
17. Which of the following checks the windings for internal shorts?
    a. Rotor winding open circuit test.
    b. Rotor current test.
    c. Rotor winding short-to-ground test.
    d. None of the above.

18. What is the most common way to test alternator diodes?
    a. Test light.
    b. Scope.
    c. Ohmmeter.
    d. Special diode tester.

Name _____

ALTERNATOR SERVICE (Continued)

19. True or false? When rebuilding an alternator, it is common practice to replace the alternator bearings.
20. When brushes are worn beyond specs:
    a. Repair them.
    b. Replace them.
    c. Soak them in oil or grease.
    d. None of the above.
21. Identify the parts of the alternator shown below.



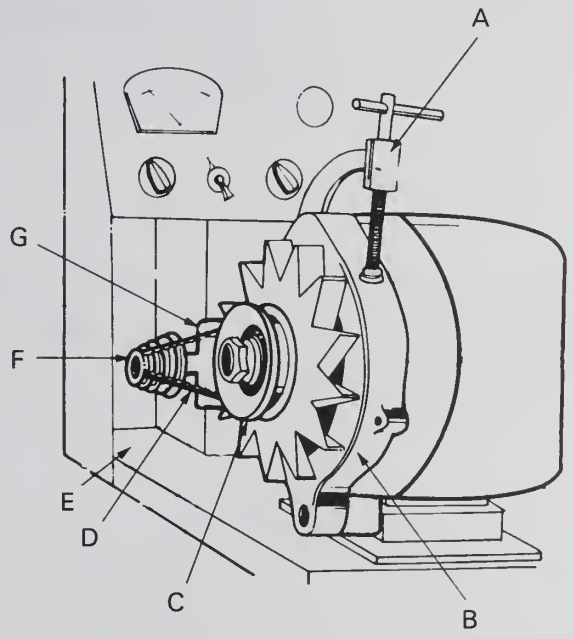
(Fiat)

A. _____
B. _____
C. _____
D. _____
E. _____
F. _____
G. _____
H. _____
I. _____
J. _____
K. _____
L. _____
M. _____
N. _____
O. _____
P. _____
Q. _____
R. _____
S. _____
T. _____
U. _____
V. _____

Name _____

ALTERNATOR SERVICE (Continued)

22. Identify the parts indicated on the diagram below.



(Florida Dept. of Voc. Ed.)

A. _____
B. _____
C. _____
D. _____
E. _____
F. _____
G. _____

REGULATOR SERVICE

23. When a regulator fails:
    a. Adjust it.
    b. Replace it.
    c. Repair it.
    d. Either a or b.
24. True or false? Turning a small adjusting screw on an electronic regulator will lower or raise the voltage setting of the regulator.
25. True or false? If you ever work on a car with a point regulator, it is best to refer back to an early service manual.

Chapter 25

IGNITION SYSTEM DIAGNOSIS AND REPAIR

Name _____

Date _____ Period _____

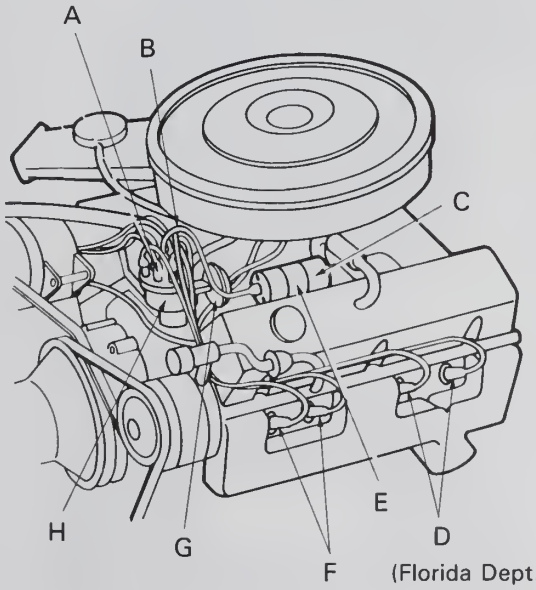
Instructor _____

OBJECTIVE: After studying this chapter, you will be able to explain how ignition system diagnosis and repair are done.

INSTRUCTIONS: As you study the text, complete the workbook problems.

TROUBLESHOOTING IGNITION PROBLEMS

1. Identify some basic troubles that can be found in an ignition system.



(Florida Dept. of Voc. Ed.)

A. _____

B. _____

C. _____

D. _____

E. _____

F. _____

G. _____

H. _____

2. When an engine cranks or turns with the starting motor, but will not start and run, you should check for _____ and _____.
3. True or false? Unlike older ignition systems, some late model ignition systems can produce enough wattage to cause serious electrical shock.
4. A(n) _____ _____ test measures the brightness and length of the electric arc (spark) produced by the ignition system.
5. True or false? It is possible to have a good spark when there are still problems in the ignition system.
6. True or false? A dead cylinder is a cylinder that is burning fuel on the power stroke.
7. Name the four types of test equipment contained in an engine analyzer.

_____

_____

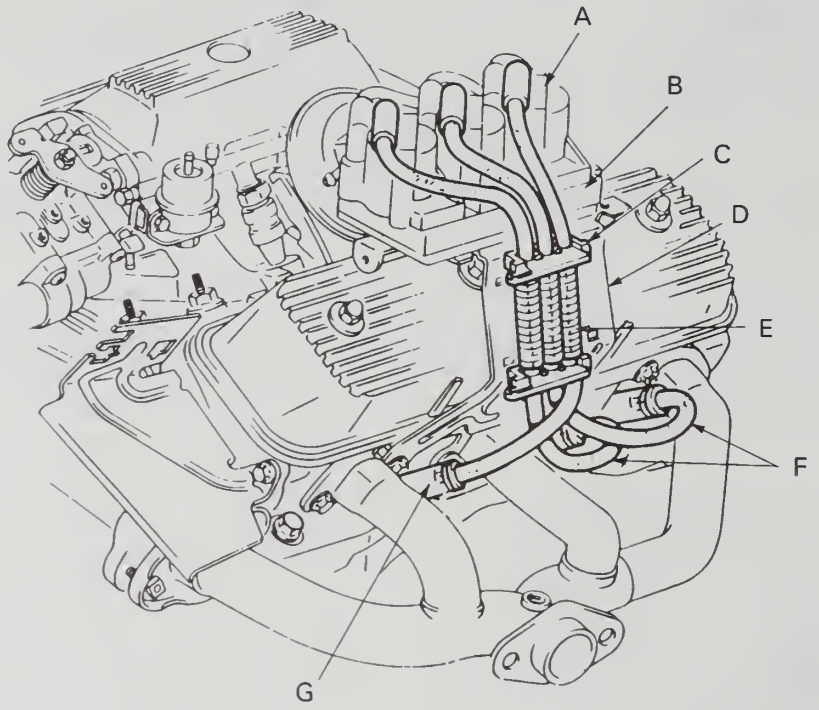
_____

_____

Name _____

SPARK PLUG AND COIL WIRE SERVICE

8. Identify the types of trouble to look for when inspecting secondary wires.



A. _____ E. _____

B. _____ F. _____

C. _____ G. _____

D. _____

9. A(n) _____ _____ _____ test is used to check the condition of a spark plug or coil wire conductor.
10. True or false? A bad spark plug wire will often have almost infinite resistance.
11. A(n) _____ _____ _____ test is used to check for sparks arcing through the insulation to ground.
12. Spark plug _____ _____ is a condition where electric arcs pass through the wire insulation.

Name _____

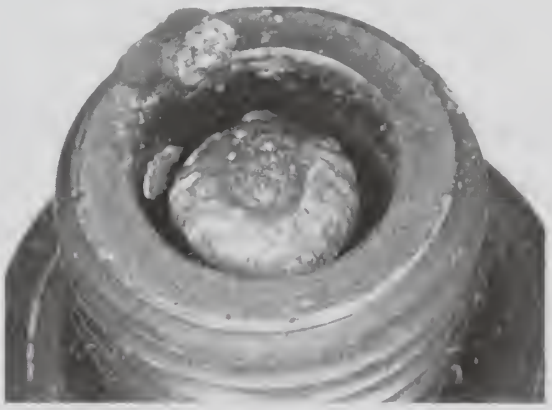
SERVICING SPARK PLUGS

13. To test spark plugs, use a(n) _____.
14. A spark plug should be removed by:
    a. Pulling on the wire.
    b. Grasping and pulling on the boot.
    c. Either a or b.
    d. None of the above.
15. Indicate the condition of each of the spark plugs below.

A

B

C



D (Champion Spark Plugs)

A. _____

_____

B. _____

_____

C. _____

_____

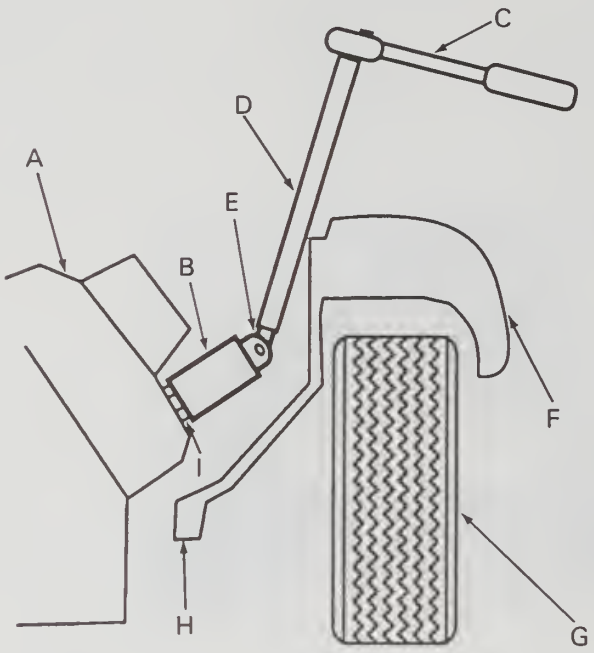
D. _____

_____

Name _____

SERVICING SPARK PLUGS (Continued)

16. Spark plug gaps vary from approximately _____ inch (_____ mm) on contact point ignitions to over _____ inch (_____ mm) on electronic systems.
17. Identify the items indicated in the diagram below.



A. _____
B. _____
C. _____
D. _____
E. _____
F. _____
G. _____
H. _____
I. _____

DISTRIBUTOR SERVICE

18. A carbon trace can:
    a. Short coil voltage to ground or to a wrong terminal lug in the distributor cap.
    b. Cause the spark plugs to fire poorly.
    c. Cause the spark plugs to fire out of sequence or not at all.
    d. All of the above.
19. If a distributor cap is not installed correctly, _____ and distributor damage can result.

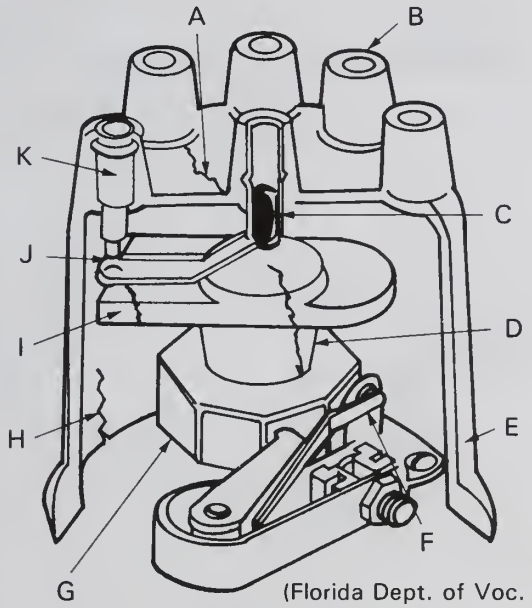
ELECTRONIC DISTRIBUTOR SERVICE

20. Most electronic type distributors use a _____ _____ to sense trigger wheel rotation and engine speed.
21. A(n) _____ _____ _____ test compares actual pickup coil resistance with specs.
22. The pickup coil air gap is the space between the pickup coil and a(n) _____ _____ tooth.

Name _____

ELECTRONIC DISTRIBUTOR SERVICE (Continued)

23. Identify the types of problems that can develop in an older contact point distributor as indicated on the diagram below.

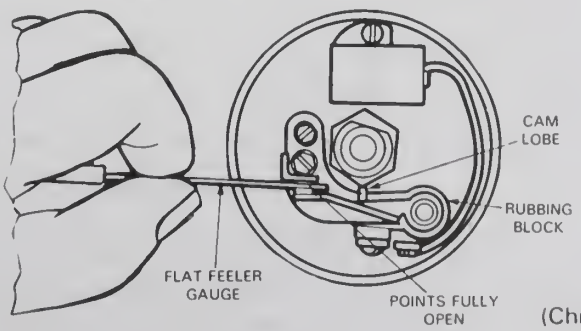


(Florida Dept. of Voc. Ed.)

A. _____
B. _____
C. _____
D. _____
E. _____
F. _____
G. _____
H. _____
I. _____
J. _____
K. _____

24. If a condenser is shorted:
    a. The engine will not start.
    b. Burning will result.
    c. Arcing will result.
    d. None of the above.
25. If distributor points are burned and pitted, or if the block is worn, the points must be:
    a. Repaired.
    b. Replaced.
    c. Left alone.
    d. None of the above.
26. True or false? Any continuous reading on the ohmmeter other than infinity means that the condenser is leaking and must be replaced.
27. What is happening in the illustration below? _____

_____

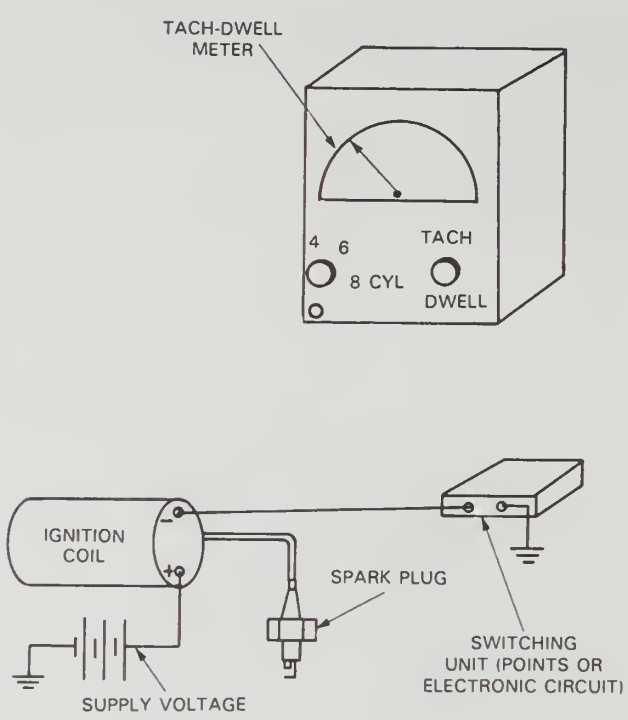


(Chrysler)

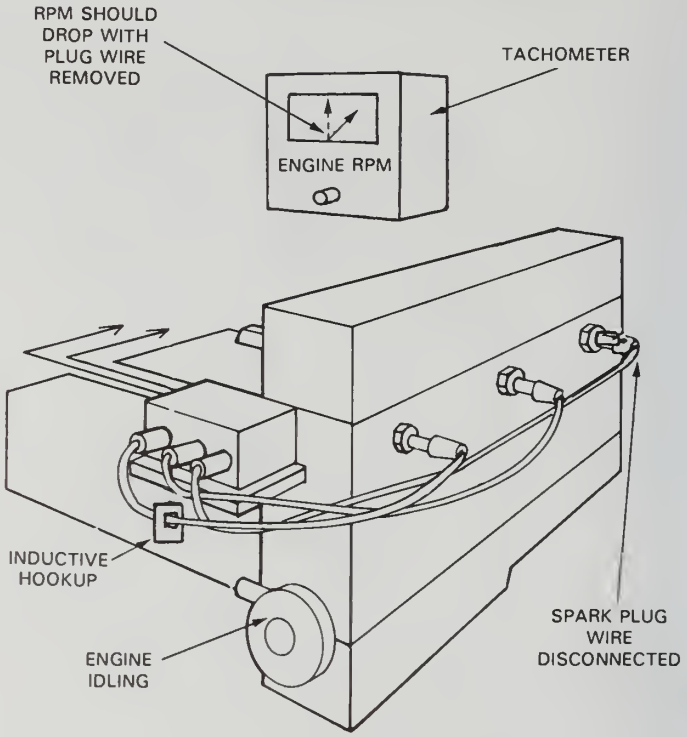
Name _____

ELECTRONIC DISTRIBUTOR SERVICE (Continued)

28. Draw in the wires connecting the tach-dwell meter to the diagrams of the ignition systems below.



A
Older Ignition System



B
Distributorless Ignition System

29. The points should always be adjusted _____ (after, before) the ignition timing.

CYLINDER BALANCE TEST

30. In the chart below, identify the problems causing the various cylinder balance test results.

CYLINDER BALANCE TEST RESULTS	SCOPE KV	PROBLEMS
1. One or more cylinders dead (no RPM drop)	High (above 5 kV)	
2. One or more cylinders dead (no RPM drop)	Low (below 5 kV)	
3. One or more cylinders low	Low	
4. One or more cylinders low	High	
5. Two adjacent cylinders dead or low	Low	
6. Four cylinders low. (All four cylinders use the same intake manifold passageway)	High	

Name _____

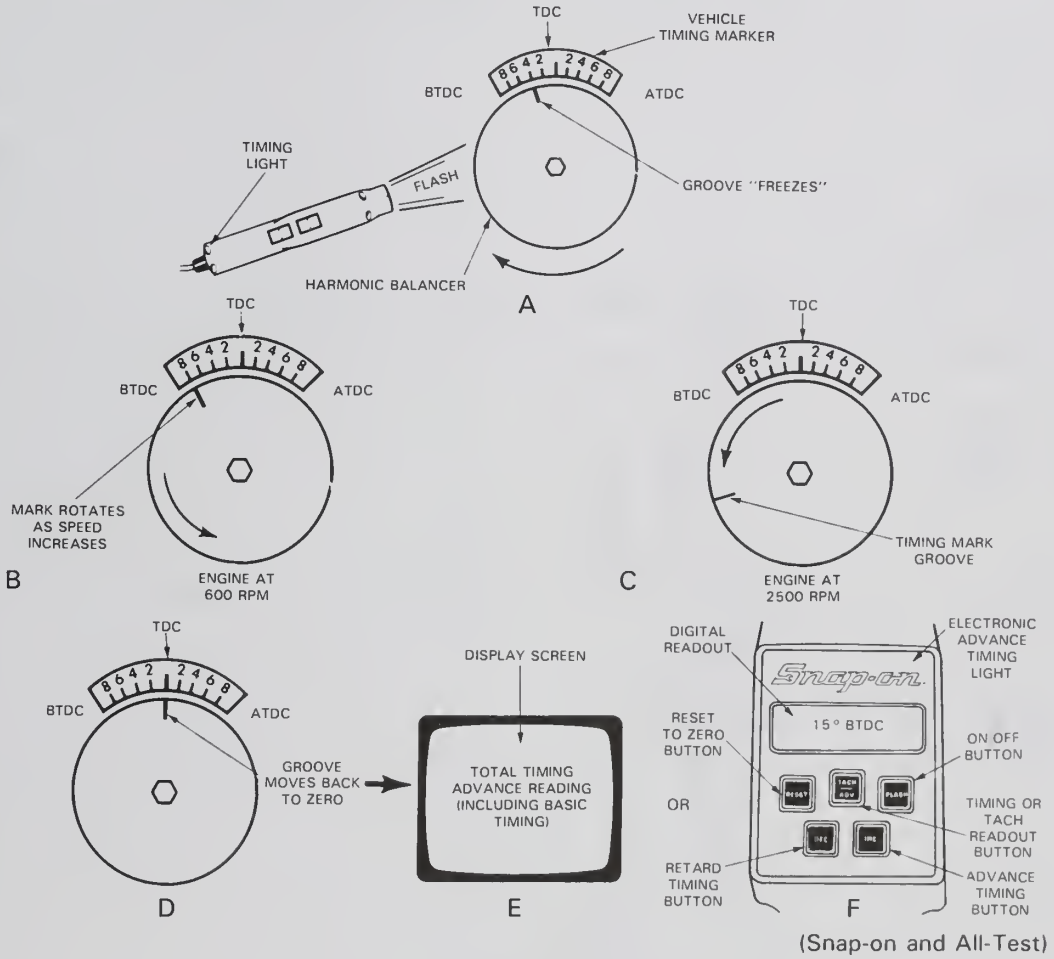
IGNITION TIMING ADJUSTMENT

31. True or false? When ignition timing is too retarded, the engine may suffer from spark knock or ping.

32. A(n) _____ _____ is used to measure ignition timing.

DISTRIBUTOR ADVANCE SERVICE

33. Describe what is happening in each of the diagrams below.



(Snap-on and All-Test)

A. _____

_____

B. _____

_____

C. _____

_____

D. _____

_____

E. _____

_____

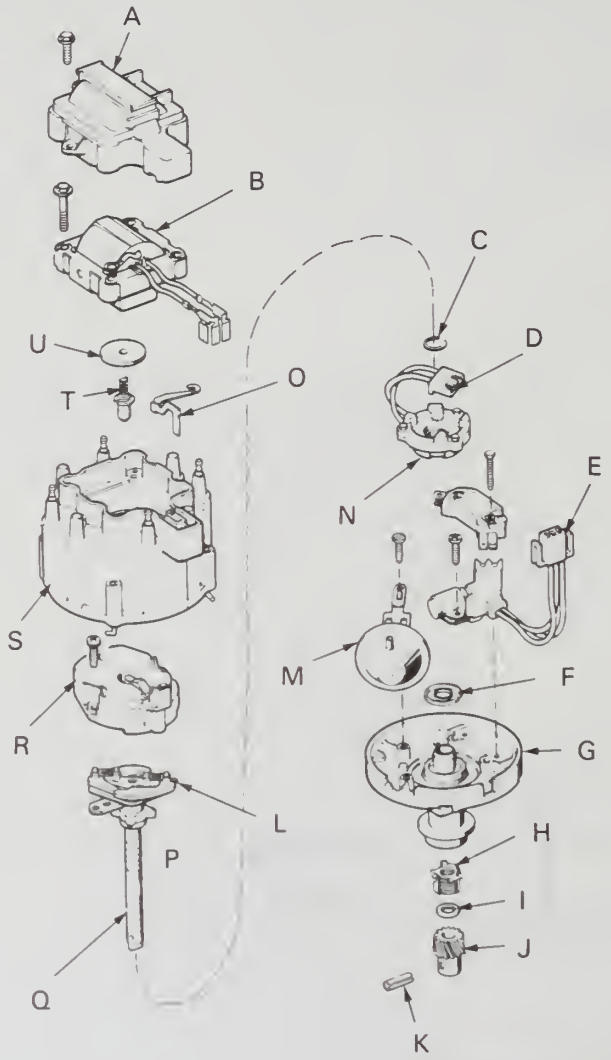
F. _____

_____

Name _____

DISTRIBUTOR ADVANCE SERVICE (Continued)

34. When a vacuum advance is used, use a vacuum pump to activate the diaphragm while measuring _____ change.
35. True or false? When adjusting ignition timing, the distributor belt must be removed.
36. Identify the parts indicated on the diagram of the distributor below.



(General Motors)

A. _____
B. _____
C. _____
D. _____
E. _____
F. _____
G. _____
H. _____
I. _____
J. _____
K. _____
L. _____
M. _____
N. _____
O. _____
P. _____
Q. _____
R. _____
S. _____
T. _____
U. _____

IGNITION RESISTANCE CIRCUIT TESTING

37. A(n) _____ _____ test may be needed when the voltage to the ignition coil in the run position is below or above specs.

Name _____

IGNITION COIL SERVICE

38. True or false? When testing an ignition coil, resistance of primary windings should be approximately one ohm.

39. A(n) _____ _____ is an easy way to check the action of an ignition switch.

IGNITION SUPPLY VOLTAGE TEST

40. Name components where an ignition supply voltage test will help locate troubles.

_____

_____

_____

_____

IGNITION CONTROL UNIT SERVICE

41. Explain why, quite often, an ignition control unit problem will show up after a period of engine operation. _____

_____

_____

_____

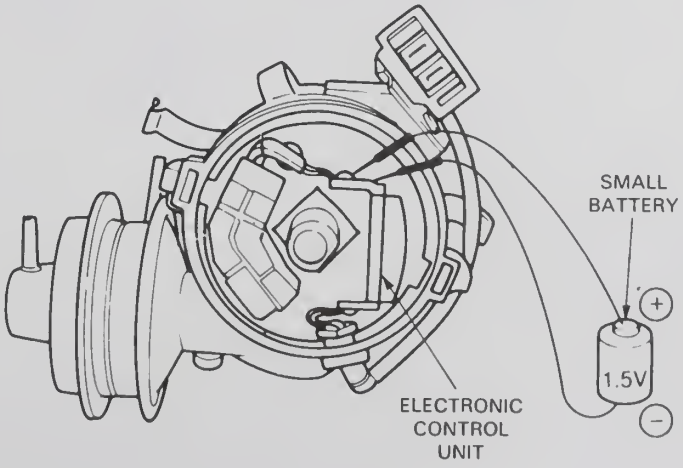
42. Describe what is happening in the diagram below. _____

_____

_____

_____

_____



Name _____

IGNITION CONTROL UNIT SERVICE (Continued)

43. When heating an ignition control unit to test it, heat the electronic control unit to a temperature:
    a. Equal to its normal operating temperature.
    b. Higher than its normal operating temperature.
    c. Lower than its normal operating temperature.
    d. The unit should never be heated.

COMPUTERIZED IGNITION SYSTEM SERVICE

44. True or false? A computerized ignition system can be seriously damaged if the wrong wire is shorted to ground or if a meter is connected improperly.

BASE TIMING

45. When in the base timing mode, you can use a conventional timing light to measure _____ _____.

Chapter 26

LIGHTING SYSTEM DIAGNOSIS AND REPAIR

Name _____

Date _____ Period _____

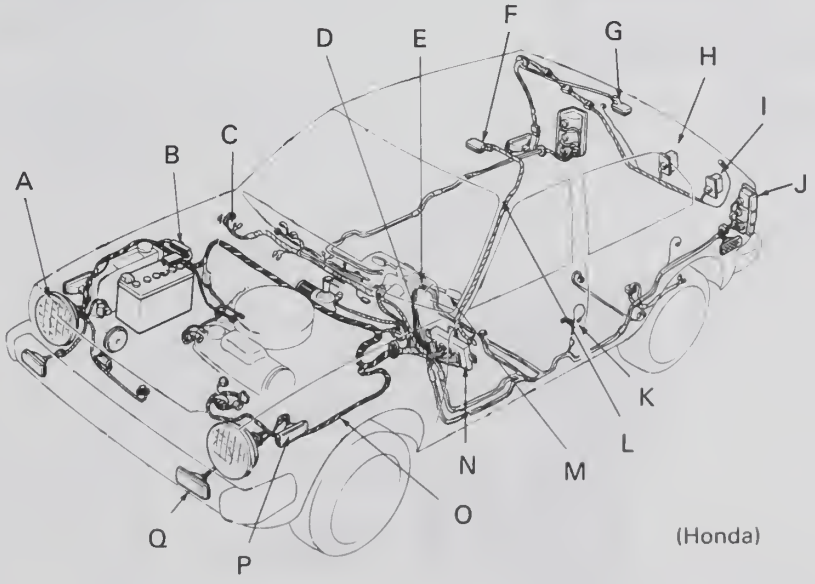
Instructor _____

OBJECTIVE: After studying this chapter, you will be able to perform lighting system diagnosis and repair.

INSTRUCTIONS: As you study the text, complete the workbook problems.

LIGHTING SYSTEM DIAGNOSIS

1. True or false? Normally, several bulbs will not burn out all at once.
2. If all the bulbs in a circuit are out:
   a. Replace them.
   b. You could have a bad circuit breaker or relay.
   c. You could have a blown fuse.
   d. Either b or c above.
3. Identify the types of problems that can occur in the lighting system of a car.



(Honda)

A. _____

B. _____

C. _____

D. _____

E. _____

F. _____

G. _____

H. _____

I. _____

J. _____

K. _____

L. _____

M. _____

N. _____

O. _____

P. _____

Q. _____

Name _____

LIGHTING SYSTEM DIAGNOSIS (Continued)

4. What might cause lights to flicker on and off? _____

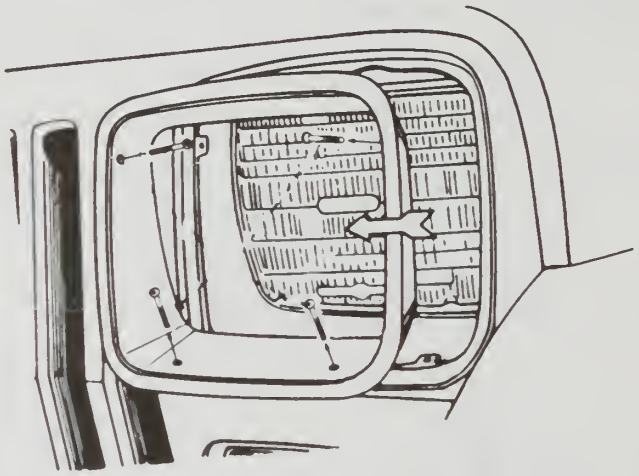
_____

_____

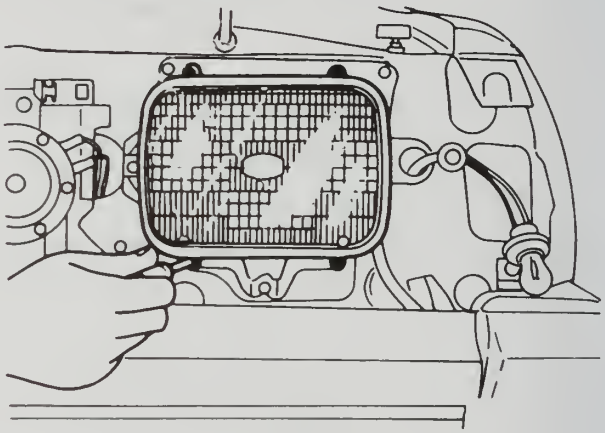
5. The most common cause of high resistance and dim bulbs is a _____ plug terminal or socket.

HEADLIGHT SERVICE

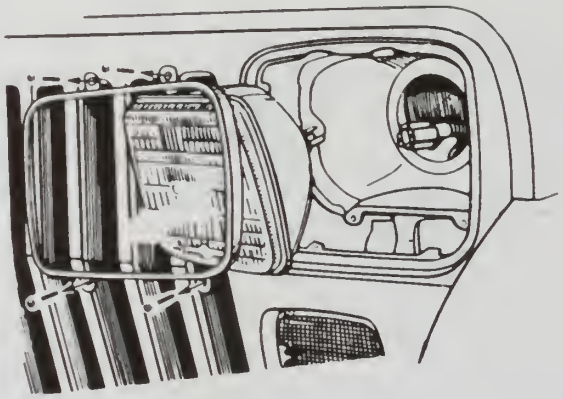
6. Look at the diagrams below. List the basic steps for the replacement of a conventional sealed headlamp.



A



B



C

A. _____

_____

B. _____

_____

C. _____

_____

Name _____

HEADLAMP SERVICE (Continued)

7. Explain why you should avoid touching a bulb with your fingers. _____

_____

_____

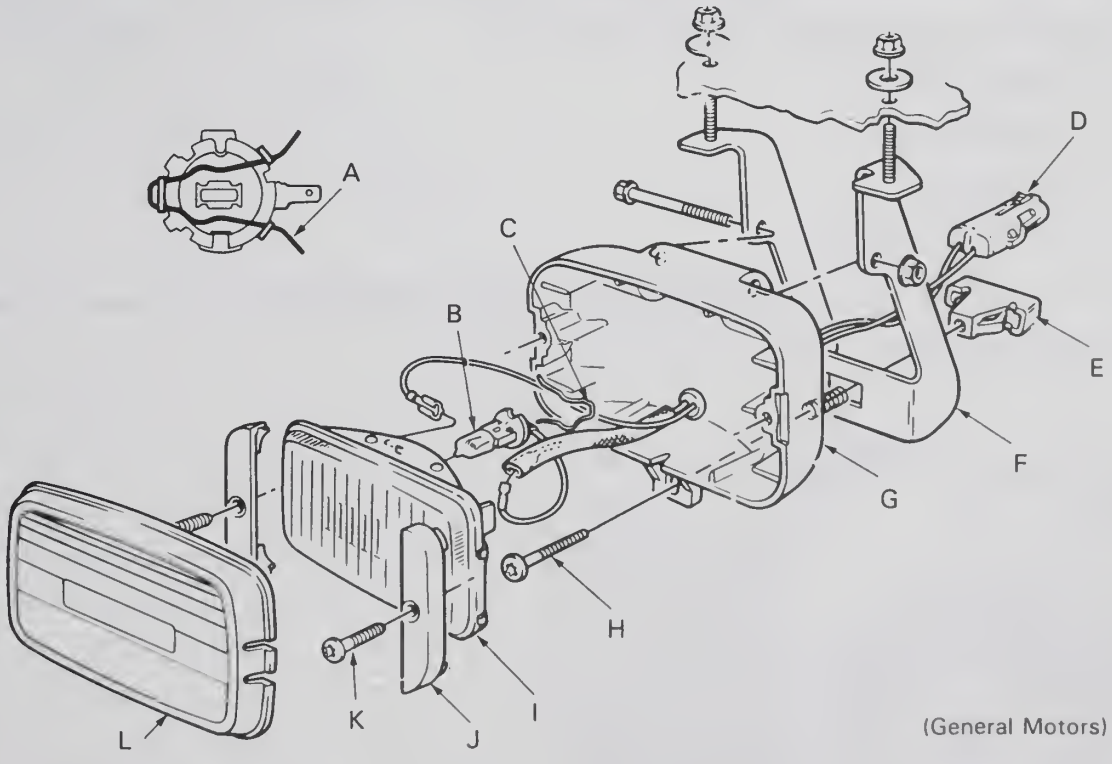
_____

_____

8. _____ _____ involves adjusting the bulbs so that they are pointing at a specified height and direction in front of the car.
9. After turning the aiming _____, recheck the reading on the headlamp aimers or how the lamps show on a marked wall.
10. True or false? A bad dimmer switch can be shorted or open on one or both sides.
11. True or false? A bad headlamp switch can be shorted or open preventing both headlights from working.

FOG LAMP SERVICE

12. Identify the parts indicated on the fog lamp circuit below.



(General Motors)

A. _____
B. _____
C. _____
D. _____
E. _____
F. _____
G. _____
H. _____
I. _____
J. _____
K. _____
L. _____

Name _____

BULB SOCKET SERVICE

13. The most common automotive bulb is the _____ that has two elements and staggered socket lugs.
14. True or false? The 1046 bulb is commonly used for parking, turn, and stop light bulbs.

FLASHER SERVICE

15. True or false? A bad flasher will make a clicking sound.

TURN SIGNAL SWITCH SERVICE

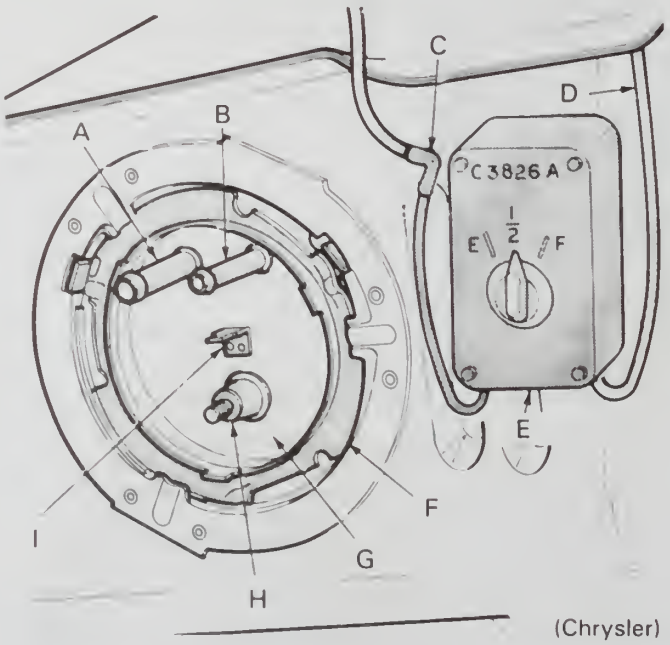
16. A combination switch that combines the turn signal switch with the headlamp, washer-wiper, and other switches, makes diagnosis:
    a. Impossible.
    b. More challenging.
    c. Very easy.
    d. None of the above.

BRAKE LIGHT SWITCH SERVICE

17. Most brake light switches are mounted on the:
    a. Steering column.
    b. Headlight switch.
    c. Brake pedal.
    d. None of the above.

INSTRUMENTATION SERVICE

18. Identify the parts indicated on the diagrams below.



(Chrysler)

A. _____
B. _____
C. _____
D. _____
E. _____
F. _____
G. _____
H. _____
I. _____

Name _____

INSTRUMENTATION SERVICE (Continued)

19. When replacing a digital dash cluster, many units have a removable _____ _____ _____ that electronically stores the mileage on the car.

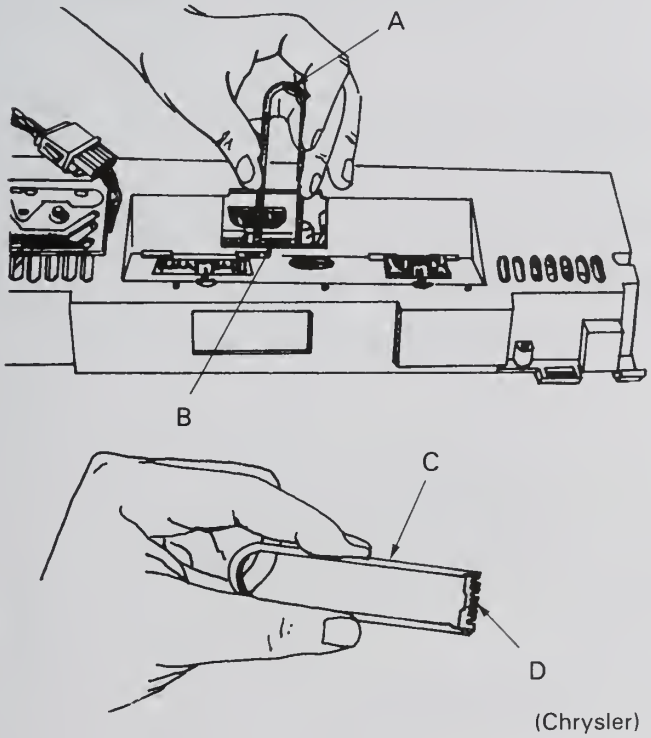
20. Identify the items indicated in the diagram below.

A. _____

B. _____

C. _____

D. _____



(Chrysler)

Chapter 27

TESTING AND REPAIRING OTHER SYSTEMS

Name _____

Date _____ Period _____

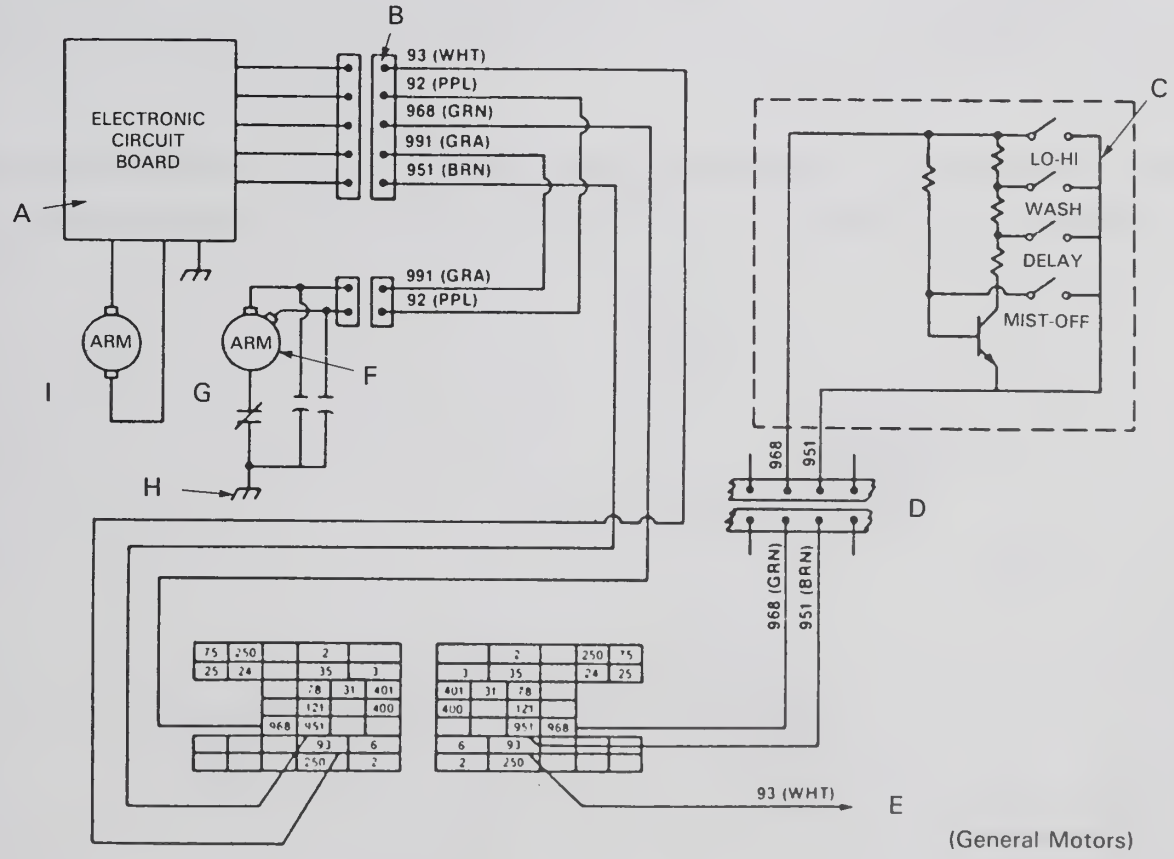
Instructor _____

OBJECTIVE: After studying this chapter, you will be able to test and repair items such as wiper-washer systems, horns, power windows, locks, and seats, radios, antilock brakes, window defoggers, heaters, air conditioners, and speed control systems.

INSTRUCTIONS: As you study the text, complete the workbook problems.

WIPER-WASHER SYSTEM TESTING AND REPAIR

1. Identify the types of problems that can be found in a wiper system.



(General Motors)

A. _____

B. _____

C. _____

D. _____

E. _____

F. _____

G. _____

H. _____

I. _____

Name _____

WIPER-WASHER SYSTEM TESTING AND REPAIR (Continued)

2. If you can hear the wiper motor running, but the wiper arms do not move, the cause may be:
   a. A stripped gear.
   b. A disconnected arm.
   c. A bad switch.
   d. Either a or b.
3. List five possible causes of an inoperative windshield washer.

_____

_____

_____

_____

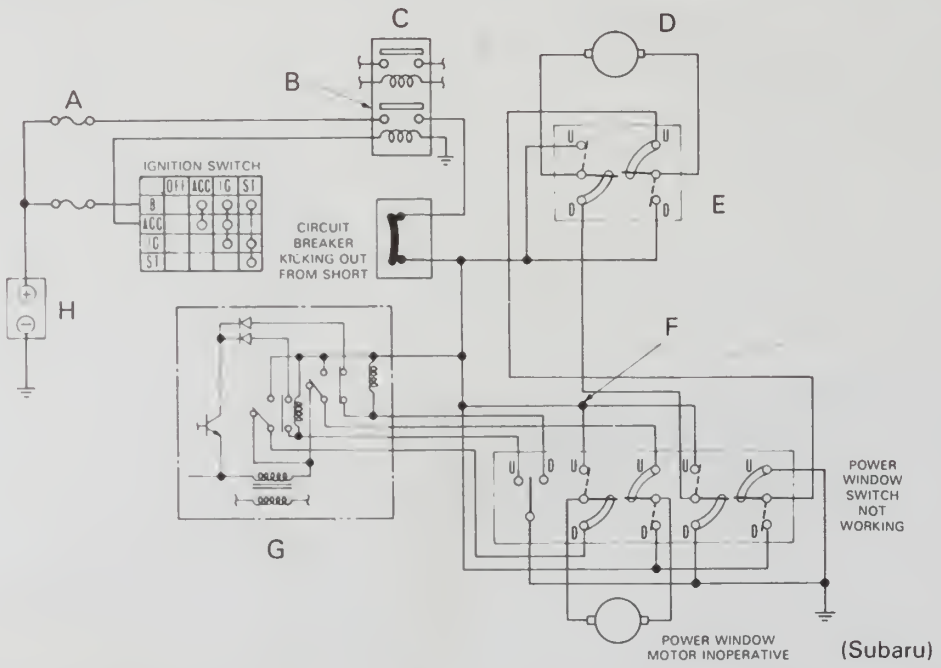
_____

HORN SERVICE

4. If the test light goes on and off as the horn button is pressed, the horn is probably _____ (bad, good).

POWER WINDOW SERVICE

5. On the diagram below, identify possible troubles for a typical power window circuit.



(Subaru)

A. _____ E. _____

B. _____ F. _____

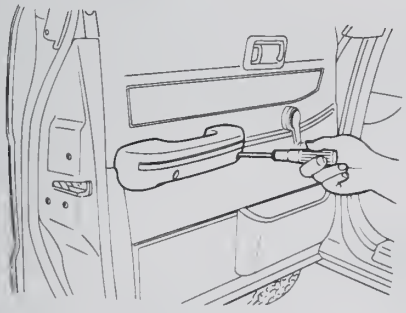
C. _____ G. _____

D. _____ H. _____

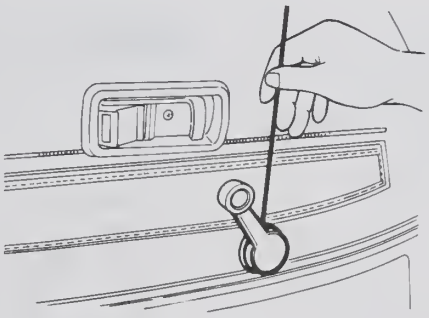
Name _____

POWER DOOR LOCK SERVICE

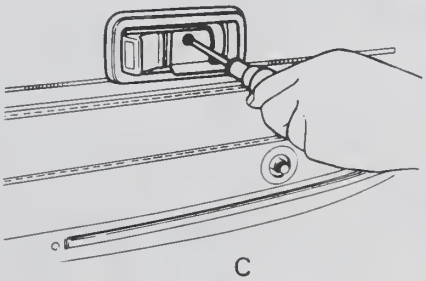
6. Describe the typical steps for door panel removal as illustrated below.



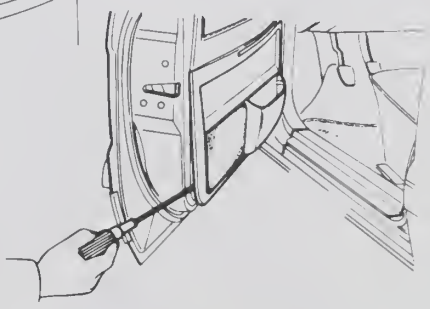
A



B



C



D

(Subaru)

A. _____

_____

B. _____

_____

C. _____

_____

D. _____

_____

POWER SEAT SERVICE

7. If any one of the seats is inoperative, what should you test?_____

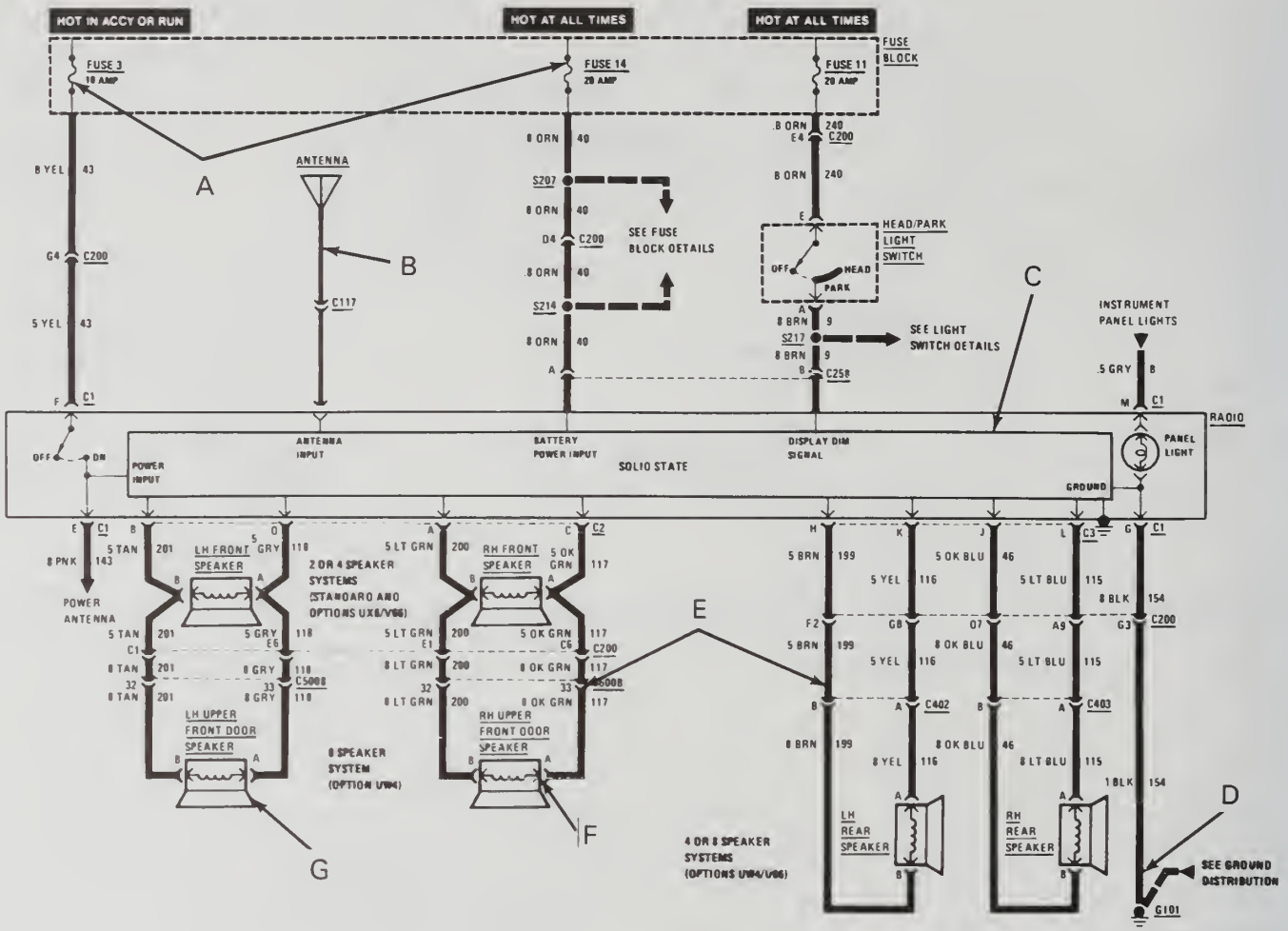
_____

_____

Name _____

RADIO SERVICE

8. Identify problems that could develop in a radio circuit.



(Oldsmobile)

A. _____ E. _____

B. _____ F. _____

C. _____ G. _____

D. _____

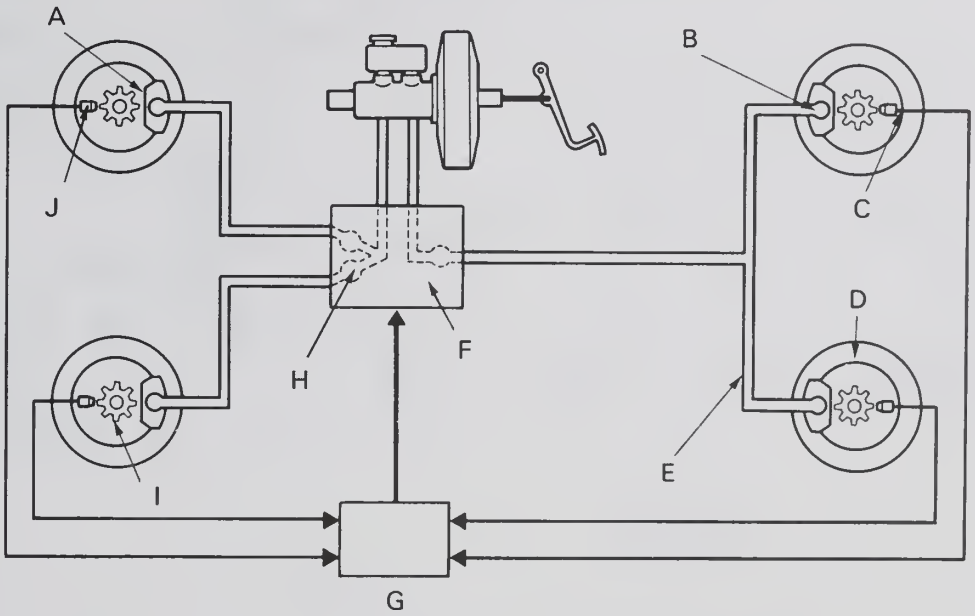
9. _____ _____ are capacitors that absorb voltage fluctuation in the car's electrical system.

10. True or false? Speakers are normally not repairable and should be replaced when defective.

Name _____

ANTILOCK BRAKE SYSTEM SERVICE

11. Identify problems that can develop in an antilock brake system.



A. _____ F. _____

B. _____ G. _____

C. _____ H. _____

D. _____ I. _____

E. _____ J. _____

12. True or false? A bad wheel speed sensor will normally be opened and will not produce wheel rpm signal for the computer.

13. Explain why you should always release hydraulic pressure before working on an ABS hydraulic unit.

_____

_____

REAR WINDOW DEFOGGER SERVICE

14. List four causes of an inoperative rear window defogger circuit.

_____

_____

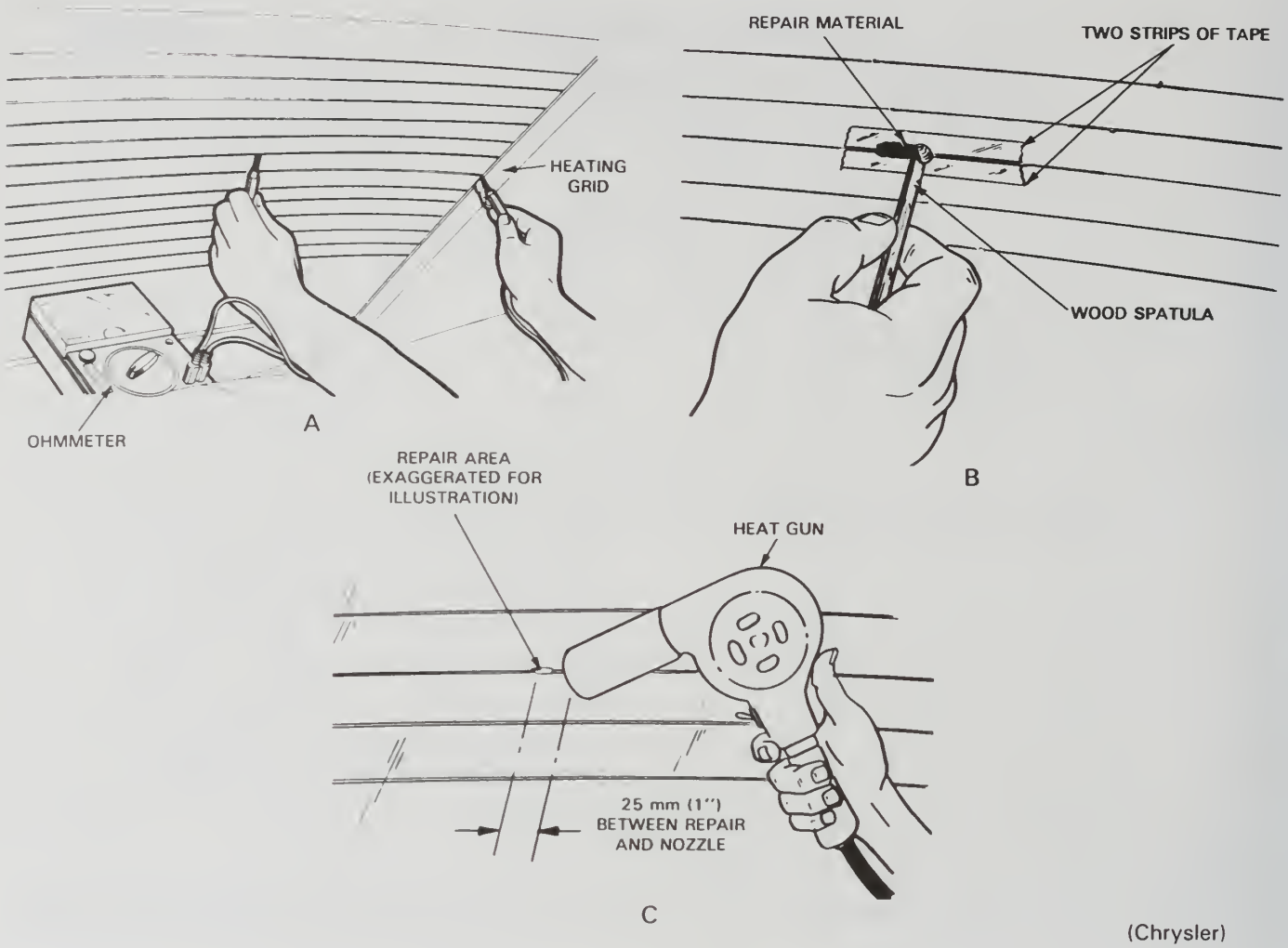
_____

_____

Name _____

REAR WINDOW DEFOGGER SERVICE (Continued)

15. Describe what is happening in each of the diagrams below.



(Chrysler)

A. _____

B. _____

C. _____

HEATER, AIR CONDITIONING CIRCUIT REPAIRS

16. True or false? The circuits for the heater blower and air conditioning systems are basically the same from car to car.

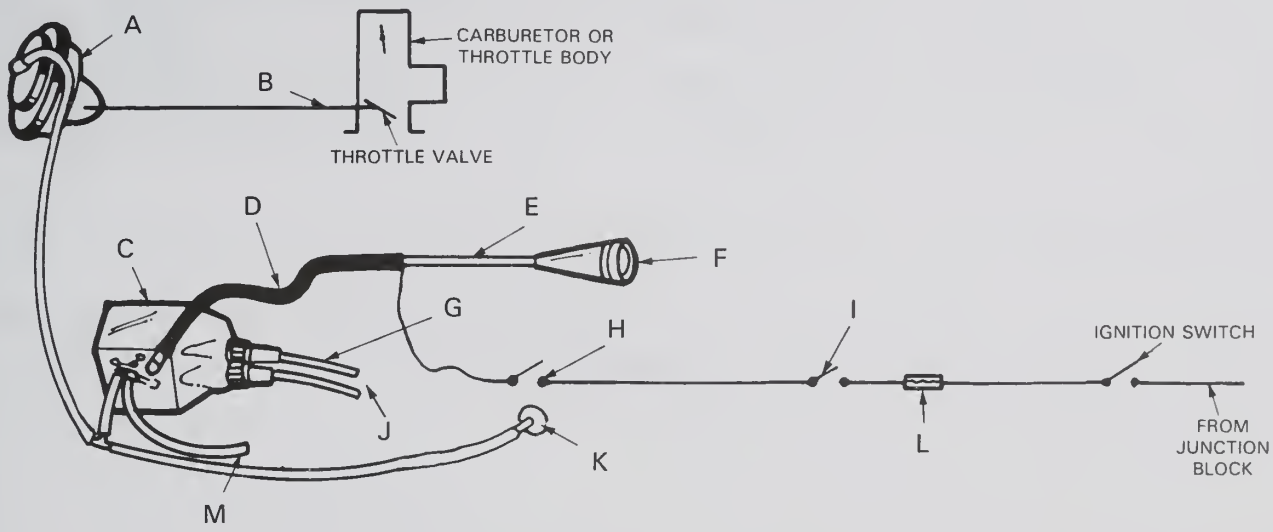
17. A bad blower resistor pack will prevent the fan or blower operation on one of the _____ (higher, slower) speed settings.

18. True or false? In most cases, the blower motor must be replaced when bearings are noisy.

Name _____

SPEED CONTROL SYSTEM SERVICE

19. Identify the types of problems that can develop in a speed control system.



A. _____
B. _____
C. _____
D. _____
E. _____
F. _____
G. _____
H. _____
I. _____
J. _____
K. _____
L. _____
M. _____

OTHER SYSTEM SERVICE

20. Which of the following is one of the best sources of information when working on complex electrical-electronic circuits?
    a. Trial and error.
    b. A classmate.
    c. A factory service manual.
    d. None of the above.

Chapter 28

ASE ELECTRICAL SYSTEM CERTIFICATION

Name _____

Date _____ Period _____

Instructor _____

OBJECTIVE: After studying this chapter, you will be able to describe the ASE electrical system certification program.

INSTRUCTIONS: As you study the text, complete the workbook problems.

ASE (NIASE)

1. ASE stands for:
   a. American Society Exam.
   b. Autómotive Service Excellence.
   c. American System Electronics.
   d. Automotive Sales Experience.
2. The 40-member ASE board of directors represents:
   a. Education and consumer groups.
   b. Shop owners and aftermarket parts companies.
   c. Auto manufacturers and government agencies.
   d. All of the above.

VOLUNTARY CERTIFICATION

3. True or false? ASE tests license technicians.
4. True or false? Over 300,000 technicians have taken ASE certification tests and passed them.

TEST CATEGORIES

5. Name the eight ASE automotive test categories.

_____

_____

_____

_____

_____

_____

_____

_____

Name _____

TEST CATEGORIES (Continued)

6. If you pass all of the certification test categories and meet the experience requirements, you are a:
   a. Certified Automobile Technician.
   b. Master Automobile Technician.
   c. Licensed Automobile Technician.
   d. None of the above.
7. Explain why you should study both the theory and service chapters of this book. _____

ASE TESTS

8. True or false? To take ASE certification tests and receive certification, you must either have two years of on-the-job experience or one year of approved educational credit and one year of work experience.
9. List eight tips that might help you pass the ASE certification tests.
10. Name three benefits of ASE certification.

SAMPLE ASE ELECTRICAL SYSTEM CERTIFICATION TEST

Name _____

Date _____ Period _____

Instructor _____

OBJECTIVE: After completing this sample test, you will be better prepared to pass the ASE Electrical Systems Certification Test.

INSTRUCTIONS: Take the following test as you would an actual ASE Certification Test. DO NOT use your textbook. Answer all the questions in the allotted time period. Follow the test taking techniques described in Chapter 28 of the textbook. After scoring the test, restudy the questions you answered incorrectly.

The following questions are similar to the ones that may appear on the ASE Electrical Systems Certification Test. They ARE NOT actual ASE test questions. The purpose of this sample test is to allow you to gain experience in answering these types of questions. Also, this sample test can point out the subject areas in which you may need improvement.

1. A customer drives into the shop and says his/her car is running rough.
   Technician A believes the computer system should be checked out first.
   Technician B believes that the car should first be inspected for a more conventional type of problem, such as a loose vacuum hose, a bad plug wire, or a fouled plug.
   Who is correct?
   a. Technician A.
   b. Technician B.
   c. Both Technicians A and B.
   d. Neither Technician A nor B.

2. Which of these can affect the performance of a computer system?
   a. Sensor problems.
   b. Actuator problem.
   c. Engine mechanical trouble.
   d. All of the above.

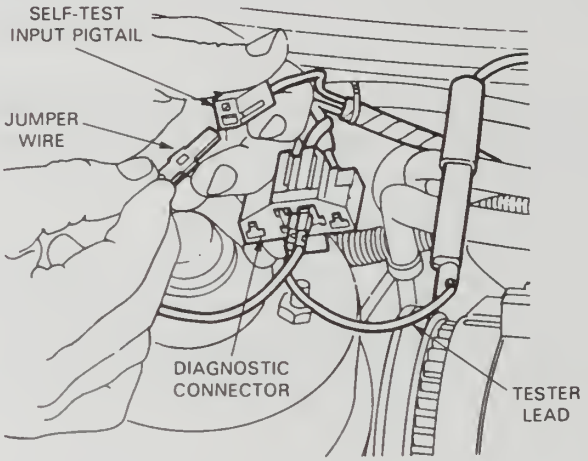
3. Which of these IS NOT a common location for a diagnostic connector?
   a. Near fuse box under dash.
   b. Under center console.
   c. Near inner fender panel in engine compartment.
   d. Near left backup light in trunk.

4. Technician A says that some self-diagnosis computer trouble codes can be activated by connecting a jumper wire across two of the terminals in the computer self-test connector.
   Technician B says that some self-diagnosis computer trouble codes can be activated by pushing two dash climate control buttons at the same time.
   Who is correct?
   a. Technician A.
   b. Technician B.
   c. Both Technicians A and B.
   d. Neither Technician A nor B.

Name _____

5. Technician A says that reading computer self-test trouble codes involves noting the output after the self-test connector has been energized.
   Technician B says that reading computer self-test trouble codes involves noting the output before the self-test connector has been energized.
   Who is correct?
   a. Technician A.
   b. Technician B.
   c. Both Technicians A and B.
   d. Neither Technician A nor B.

6. In the illustration, the technician is activating self-test trouble codes in a:
   a. Chrysler vehicle.
   b. Ford vehicle.
   c. GM vehicle.
   d. None of the above.



7. The computer's diagnostic mode has been energized. The CHECK ENGINE light flashes twice then pauses and flashes four more times. What trouble code is indicated?
   a. 6.
   b. 4.
   c. 24.
   d. 2.

8. Two trouble codes have been displayed on the climate control panel. One of the codes indicates a faulty oxygen sensor.
   Technician A says the oxygen sensor should be replaced.
   Technician B says other systems should be checked first, before replacing the oxygen sensor.
   Who is correct?
   a. Technician A.
   b. Technician B.
   c. Both Technicians A and B.
   d. Neither Technician A nor B.

Name _____

9. Where are computer terminal values tested?
   a. At the ignition coil.
   b. At the MAP sensor.
   c. At the metal pins of the ECU.
   d. None of the above.

10. An automobile has been serviced in the shop, but the diagnostic trouble codes still remain in the vehicle's computer memory.
    Technician A says these trouble codes can be erased from the computer's memory by disconnecting the battery ground strap or cable.
    Technician B says these trouble codes will erase automatically after 30 to 50 engine starts.
    Who is correct?
    a. Technician A.
    b. Technician B.
    c. Both Technicians A and B.
    d. Neither Technician A nor B.

11. Which of the following IS NOT a function of a computer analyzer?
    a. A computer analyzer can read trouble codes.
    b. A computer analyzer can show actual electrical values.
    c. Depending on the type, some can even energize actuators.
    d. None of the above.

12. Technician A says the testing equipment shown below is a diagnostic computer analyzer.
    Technician B says the testing equipment shown below is an engine analyzer.
    Who is correct?
    a. Technician A.
    b. Technician B.
    c. Both Technicians A and B.
    d. Neither Technician A nor B.

(Sun Electric Corp.)

Name _____

13. An engine analyzer is connected to an automobile's engine. The oscilloscope is activated.
Technician A says scope voltage will appear on the screen along the horizontal axis or scale.
Technician B says scope voltage will appear on the screen along the vertical axis or scale.
Who is correct?
a. Technician A.
b. Technician B.
c. Both Technicians A and B.
d. Neither Technician A nor B.

14. Technician A says the scope voltage pattern for an electronic ignition will vary from the voltage pattern of a contact point type ignition system.
Techician B says the scope voltage pattern for an electronic ignition will always be identical to that of a contact point type ignition system.
Who is correct?
a. Technician A.
b. Technician B.
c. Both Technicians A and B.
d. Neither Technician A nor B.

15. The CO readings for a particular automobile engine are too high.
Technician A says this condition may be caused by a high carburetor float setting.
Technician B says this condition may be caused by a low idle speed setting.
Who is correct?
a. Technician A.
b. Technician B.
c. Both Technicians A and B.
d. Neither Technician A nor B.

16. An exhaust analyzer's oxygen reading should normally be:
a. Between 1.5 and 2.0 percent.
b. Between .9 and 1.3 percent.
c. Between .1 and 7 percent.
d. Between 7 and 9 percent.

17. An automobile is brought into the shop. Its computer trouble codes are activated. One of the trouble codes indicates an over-rich fuel mixture.
Technician A wants to check the condition of the engine oil to see if it is having an effect on the oxygen sensor's operation.
Technician B says the condition of engine oil will not have any effect on oxygen sensor performance.
Who is correct?
a. Technician A.
b. Technician B.
c. Both Technicians A and B.
d. Neither Technician A nor B.

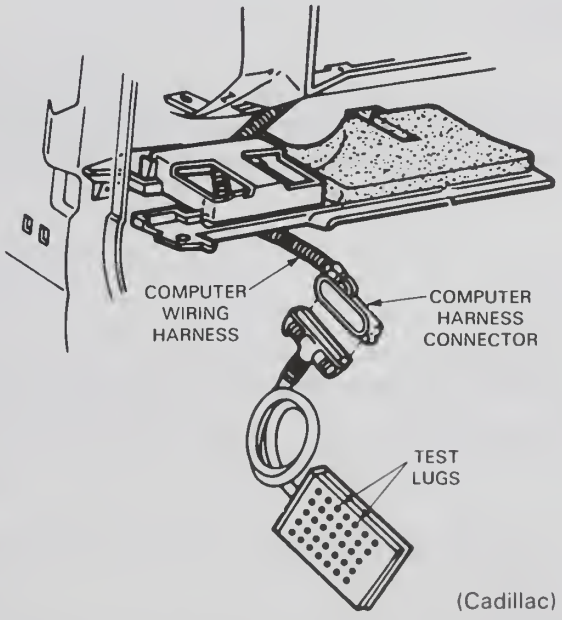
18. What is the most common cause of electrical-related problems in a computer system?
a. Dead battery.
b. Faulty ECU.
c. Sensor malfunction.
d. Poor electrical connections.

Name _____

19. Technician A says a reference voltage of five volts is normally fed to switching and variable resistance type sensors.
Technician B says a reference voltage of .2 volts is normally fed to switching and variable resistance type sensors.
Who is correct?
a. Technician A.
b. Technician B.
c. Both Technicians A and B.
d. Neither Technician A nor B.

20. Technician A says a faulty engine speed sensor will not keep an engine from running.
Technician B says a faulty engine speed sensor will sometimes keep an engine from running.
Who is correct?
a. Technician A.
b. Technician B.
c. Both Technicians A and B.
d. Neither Technician A nor B.

21. What type of computer system test equipment is being used in the illustration below?
a. Digital ohmmeter.
b. Diagnostic computer analyzer.
c. Breakout box.
d. Analog voltmeter.



(Cadillac)

22. Technician A says a bad vehicle speed sensor will always keep an engine from running.
Technician B says a bad vehicle speed sensor will normally reduce engine performance and fuel economy.
Who is correct?
a. Technician A.
b. Technician B.
c. Both Technicians A and B.
d. Neither Technician A nor B.

Name _____

23. How long are oxygen sensors normally designed to last?
    a. 100,000 miles.
    b. 50,000 miles.
    c. 25,000 miles.
    d. 10,000 miles.

24. Which of the following will not cause oxygen sensor contamination?
    a. Leaded fuel.
    b. Gasoline additives.
    c. Carbon.
    d. None of the above.

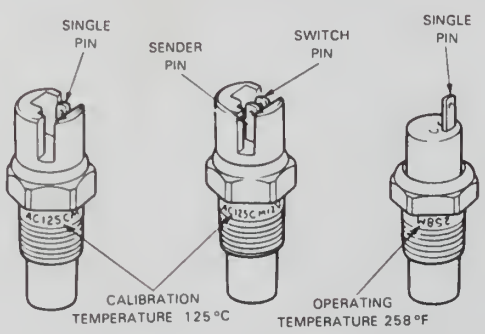
25. What is the average voltage output of an oxygen sensor?
    a. 7.9 volts.
    b. 5.0 volts.
    c. .5 volts.
    d. 2.4 volts.

26. Technician A wants to use a low resistance meter to measure oxygen sensor voltage.
    Technician B wants to use a high impedance, digital meter to measure oxygen sensor voltage.
    Who is correct?
    a. Technician A.
    b. Technician B.
    c. Both Technicians A and B.
    d. Neither Technician A nor B.

27. An oxygen sensor has been removed for inspection. The sensor's tip is light gray in color.
    Technician A says this indicates lead contamination, which requires sensor replacement.
    Technician B says this is a normal color for an oxygen sensor.
    Who is correct?
    a. Technician A.
    b. Technician B.
    c. Both Technicians A and B.
    d. Neither Technician A nor B.

28. Technician A says a bad manifold pressure sensor can affect the air-fuel ratio when the engine accelerates and decelerates.
    Technician B says a bad manifold pressure sensor can possibly affect ignition timing.
    Who is correct?
    a. Technician A.
    b. Technician B.
    c. Both Technicians A and B.
    d. Neither Technician A nor B.

29. What type of engine sensors are shown in the illustration below?
    a. Oxygen sensors.
    b. Coolant sensors.
    c. Air temperature sensors.
    d. None of the above.



(Pontiac)

Name _____

30. Technician A says a faulty knock sensor can affect ignition timing.
Technician B says a faulty knock sensor can affect turbocharger boost pressure.
Who is correct?
a. Technician A.
b. Technician B.
c. Both Technicians A and B.
d. Neither Technician A nor B.

31. Technician A says a diesel metering valve sensor is only used on late model diesels with computer control.
Technician B says a diesel metering valve sensor has been used on diesels for the last twenty years.
Who is correct?
a. Technician A.
b. Technician B.
c. Both Technicians A and B.
d. Neither Technician A nor B.

32. An automobile with multi-point injection is being serviced. A stethoscope is being used to test injector operation.
Technician A says if there is a clicking sound from each injector, the injectors are electrically good.
Technician B says if there is a clicking sound from each injector, the voltage supply to the injectors is below normal.
Who is correct?
a. Technician A.
b. Technician B.
c. Both Technicians A and B.
d. Neither Technician A nor B.

33. In what position should the ignition key be during ECU removal?
a. ''On'' position.
b. ''Off'' position.
c. ''Accessory'' position.
d. None of the above.

24. A fully charged battery should have a hydrometer reading of at least:
a. 8.256 or higher.
b. 5.760 or higher.
c. 1.265 or higher.
d. None of the above.

35. Which of the following battery tests is the most informative?
a. Battery voltage test.
b. Battery load test.
c. Battery hydrometer test.
d. None of the above.

36. An automobile is brought to the shop with a no-crank problem.
Technician A says this condition may be due to a discharged battery.
Technician B says this condition may be due to a bad electrical connection.
Who is correct?
a. Technician A.
b. Technician B.
c. Both Technicians A and B.
d. Neither Technician A nor B.

Name _____

37. What type of battery service equipment is shown in the illustration below?
    a. Digital voltmeter.
    b. Load tester.
    c. Boost charger.
    d. None of the above.

(Sun Electric Corp.)

38. The purpose of a starter current draw test is to measure:
    a. Input voltage at the starter motor.
    b. Input voltage at the starter solenoid.
    c. The number of amps used by the starting system.
    d. None of the above.

39. Technician A says a charging system output test measures the current and voltage output of the charging system while under a load.
    Technician B says a charging system output test measures the voltage output of the alternator.
    Who is correct?
    a. Technician A.
    b. Technician B.
    c. Both Technicians A and B.
    d. Neither Technician A nor B.

40. A regulator bypass test has been performed on an automobile's charging system. When the regulator is bypassed, charging system voltage and current increase to normal.
    Technician A says this indicates a faulty alternator.
    Technician B says this indicates a faulty regulator.
    Who is correct?
    a. Technician A.
    b. Technician B.
    c. Both Technicians A and B.
    d. Neither Technician A nor B.

41. An automobile's engine cranks, but will not start.
    Technician A says a ''spark test'' will determine the general condition of the ignition system to see if this system is at fault.
    Technician B says a ''spark test'' can only determine the general condition of the engine's ignition system primary circuit.
    Who is correct?
    a. Technician A.
    b. Technician B.
    c. Both Technicians A and B.
    d. Neither Technician A nor B.

Name _____

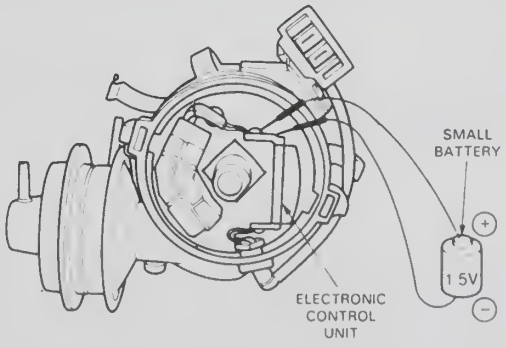
42. The purpose of a secondary wire resistance test is to check the general condition of:
    a. The ignition system wiring leading to the ECU.
    b. The ignition system wiring leading to the pickup coil.
    c. A spark plug or coil wire conductor.
    d. None of the above.

43. Technician A says bad spark plugs can produce hard starting problems for an engine.
    Technician B says bad spark plugs can produce lack of power problems for an engine.
    Who is correct?
    a. Technician A.
    b. Technician B.
    c. Both Technicians A and B.
    d. Neither Technician A nor B.

44. A properly burning spark plug should have a:
    a. Black or dark-blue color.
    b. Brown to grayish-tan color.
    c. White or light-yellow color.
    d. None of the above.

45. Technician A says while an engine is cranking, a high DC voltage should be produced by the pickup coil.
    Technician B says while an engine is cranking, a low AC voltage should be produced by the pickup coil.
    Who is correct?
    a. Technician A.
    b. Technician B.
    c. Both Technicians A and B.
    d. Neither Technician A nor B.

46. Technician A says the testing procedure shown in the illustration below is used to check the operating condition of a pickup coil.
    Technician B says the testing procedure shown in the illustration below is used to check the operating condition of the ECU.
    Who is correct?
    a. Technician A.
    b. Technician B.
    c. Both Technicians A and B.
    d. Neither Technician A nor B.

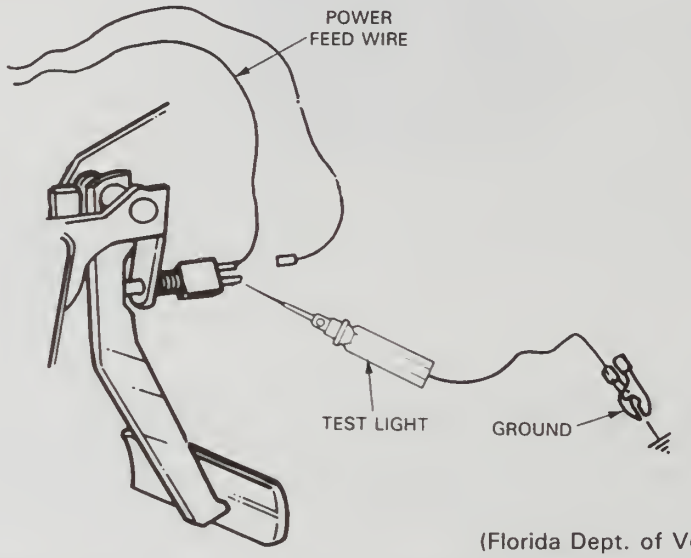


47. Technician A says an ignition supply voltage test measures the amount of voltage going to the positive terminal of the ECU.
    Technician B says an ignition supply voltage test measures the amount of voltage going to the positive terminal of the ignition coil.
    Who is correct?
    a. Technician A.
    b. Technician B.
    c. Both Technicians A and B.
    d. Neither Technician A nor B.

Name _____

48. Technician A says when an automobile's lights dim, a high resistance in the circuit is causing the problem.
Technician B says when an automobile's lights dim, a low voltage supply is causing the problem.
Who is correct?
a. Technician A.
b. Technician B.
c. Both Technicians A and B.
d. Neither Technician A nor B.

49. What type of automobile electrical service procedure is shown in the illustration below?
a. Testing operation of neutral safety switch.
b. Testing operation of brake light switch.
c. Testing operation of hazard warning flasher assembly.
d. None of the above.



(Florida Dept. of Voc. Ed.)

50. Technician A says a poor ground can cause some types of car radio interference.
Techniaian B says a bad spark plug wire can cause some types of car radio interference.
Who is correct?
a. Technician A.
b. Technician B.
c. Both Technicians A and B.
d. Neither Technician A nor B.

This sign is displayed by repair facilities that employ auto repair technicians who have been certified by the nonprofit National Institute for Automotive Service Excellence. ASE was founded to upgrade the quality of automotive service and repair. Those who have mastered the material contained in this book should be well on their way to certification and successful automotive service careers.

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